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THEO. S. CASE.

TABLE OF CONTENTS.

PAGE.

PROCEEDINGS OF SOCIETIES.

1. The 51st Annual Meeting of the American Association for the Advancement of Science. Reported by Theo. S. Case . . . 325
2. President Dawson's Address 326
3. Retiring President Brush's Address. . . . 330

ASTRONOMY.

1. Transit of Venus. Wm. Harkness 335
2. Evolution of the Earth. Rev. Sam'l Haughton 338

PHYSICS.

1. Instruction in Physics. T. C. Mendenhall. 339
2. Instrument for Determining the Location of Bullets in the Human Body. Alexander Graham Bell 341
3. Color Blindness. E. L. Nichols 343
4. The Diatonic Scales. P. H. VanderWeyde 343

CHEMISTRY.

1. Chemical Literature. H. C. Bolton. . . . 344

MECHANICAL SCIENCE.

1. Importance of Experimental Research in Mechanical Science. W. P. Trowbridge. 345
2. Aerial Navigation Practicable. Joseph L'Etoile 347
3. Aerial Navigation. W. H. Lynch 347

BIOLOGY.

1. Biology of American Mollusks. Wm. H. Dall 351

ANTHROPOLOGY.

1. Some Physical Characteristics of Native Tribes of Canada. Daniel Wilson . . . 348
2. A Scheme of Anthropology. Otis T. Mason. 355
3. The Cross and the Crucifix. Chas. Whittlesey. 357
4. A Stone Grave in Illinois. Chas. Rau . . 3 8
5. Chief Deities in American Religion. A. S. Gatschet 359
6. Beliefs and Superstitions of the Iroquois Indians Mrs. Erminnie Smith 360
7. Indian Migrations as Evidenced by Language. Horatio Hale 362
8. Affinities Between Ancient Customs in America and other Continents. J. W. Phene. 363

PAGE.

GEOLOGY AND GEOGRAPHY.

1. Geology and Mineralogy of the Pacific States. E. T. Cox 349
2. Source of Bitumen in the Ohio Shale. Edward Orton. 349
3. Successive Palæozoöic Floras of Eastern North America. J. W. Dawson 350
4. Mastodon Remains near Freehold, N. J. Samuel Lockwood 350
5. A New Geological Society 350

MICROSCOPY.

1. Histology and Microscopy. A. H. Tuttle, Chairman. 366
2. The House-Fly as a Carrier of Poison Germs. Thomas Taylor 366

ECONOMIC SCIENCE.

1. Economic Science and Statistics. E. B. Elliott 370

MISCELLANEOUS ITEMS.

1. Opening of the Peter Redpath Museum. . 371
2. Excursion to Quebec 373
3. Excursion to Ottawa 376

METEOROLOGY.

1. Kansas Weather Service.* Professor J. T. Lovewell. 379

BOOK NOTICES.*

1. Report of the Commissioner of Education for 1880 380
2. Sparks from a Geologist's Hammer. S. C. Griggs & Co 381
3. The Coues Check List of North American Birds. Estes & Lauriat 382
4. Floating Matter of the Air. D. Appleton & Co. 382
5. Collet's Historical Record 383
6. Other Publications Received 384

SCIENTIFIC MISCELLANY.

1. Some Recent Improvements in the Mechanic Arts.* F. B. Brock 384
2. Lime vs. Powder 385

EDITORIAL NOTES 386

ITEMS FROM PERIODICALS 387

*Written for the REVIEW.

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REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VI. OCTOBER, 1882. NO. 6

PROCEEDINGS OF SOCIETIES.

THE THIRTY-FIRST ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Montreal meeting of this Association was a remarkably successful one for several reasons, among which were the large number of members present, the unusual attendance of distinguished scientists from abroad, the unaccustomed surroundings of the old French city and its sisters of Quebec and Ottawa and the charming hospitality and attentions of their citizens. The trip thither and the excursions subsequently tendered were by no means the least attractions of the session and were thoroughly enjoyed by all.

While it may be out of place to describe the beauties of the majestic St. Lawrence, whose lovely islands, calm and peaceful meadows and farm lands and rather monotonous scenery call up vividly the Acadian pictures of Longfellow, and while the exciting and thrilling shooting of the rapids of the Long Sault and of Lachine, and the charms of the Falls of Montmorency, of Rideau and of Chaudiere, and even the unequaled view from Mount Royal (*Monte Real,*) itself, may be better adapted to the letter-book and the sketch-block of the tourist, one cannot resist saying that science could hardly have been evolved and promulgated among more delightful environments. Scientifically speaking, the choice of Montreal was a good one, for, aside from the fact that just twenty-five years ago the Association met there and the retrospect was fitting and flattering to the older members, the geological and mineralogical features of the region are most

interesting, the buildings where the sessions were held, McGill College, most spacious and suitable, and finally, Principal Dawson himself, the President of the Association, is one of the most distinguished *savans* of the age.

The formal opening of the session took place at William Molson Hall of McGill University, on Wednesday, August 26th.

The commodious hall was crowded to overflowing with the members and their friends, among whom were a large number of ladies. Shortly after ten o'clock the officers of the Association entered the hall amidst the applause of the audience, and took their seats upon the platform. Prof. George J. Brush, of New Haven, Conn., the retiring President of the Association, took the Chair, and among those on the platform were:—Dr. J. W. Dawson, the incoming President; Dr. T. Sterry Hunt, Chairman of the Local Committee; Mayor Beaudry, Bishop Bond, Peter Redpath, Dr. W. B. Carpenter, London, Eng.; Dr. Kowaleskwy, Moscow; Prof. Szabo, Hungary; Hon. Justice Charles Dewey Day, Chancellor of the University; Rev. Canon Henderson, Rev. Principal MacVicar, Sandford Fleming, Rev. Dr. Haughton, Dublin; Mr. Ormsby, Dr. John Rae, Dr. W. H. Hingston, Dr. Thorburn, Rev. Canon Baldwin and many others.

Prof. Brush called the meeting to order, and introduced the honored President, Dr. Dawson.

Principal J. W. Dawson, F. R. S., F. G. S., C. M. G., then took the Chair amid applause, and spoke as follows:

Ladies and Gentlemen of the Association:

I need hardly say how highly I esteem the honor you have done me in my election as your President for the present meeting. The unanimous election of a body like this to such an office is, in my judgment, the greatest distinction to which any scientific man on this continent can aspire, and I value it accordingly.

I have no doubt, however, that in the present case, the choice was in some degree determined by the wish to do honor to Canada, and to give to this meeting a character as thoroughly international as possible.

But this view of the reasons for the election by no means detracts from its value. On the contrary, it places the presidency of this Association on a broader basis than that of any other office extending over all this wide continent, and thus including all that belongs to the powers that reign both at Washington and Ottawa. Science from her serene height thus overlooks all national boundaries and comprehends this whole world in her scope of vision.

It becomes your office, therefore, for the time being, to merge the character of citizens of the United States or Canada in that of cosmopolitan men of science. This is what I propose to attempt in endeavoring to perform the duties to which you have called me; and you will, therefore, kindly regard me as not a Canadian, nor an American, in the narrower sense of that term, but as the President of a society which, in meeting here, assumes a continental and international character.

The Lord Bishop of Montreal was then called upon to ask the Divine blessing upon the Association's meetings.

Dr. T. Sterry Hunt, Montreal, Chairman of the Local Committee, then rose and addressed the assembly, welcoming, on behalf of the Local Committee, all those present to the city of Montreal. On this occasion there arose before them many interesting memories of the past. Some five-and-twenty years had now passed away since the American Association for the Advancement of Science had held their first meeting in Canada, in this very city of Montreal. Of the members of the then Local Committee only three were with them to-day,—their new President, Dr. J. W. Dawson, Dr. W. H. Hingston, and the speaker. Looking back that time seemed a day of small things. Those who saw Montreal then saw a little city of 50,000 to 60,000 souls; to-day His Worship the Mayor held jurisdiction over some 150,000 persons. The Association then numbered about 400 members; to-day it had no less than 2,000 members, so that it would be perceived that the Association and the city had grown together, and the infant college of which Dr. Dawson had then just assumed the helm, had grown to be a great and noble university. Its museum and rare collections, then so small, now required a separate structure to themselves. The Association which held session to-day was popular, and justly so, for it went from city to city diffusing its knowledge broadcast throughout the land irrespective of race or nationality. After referring to the German Society the speaker went on to speak of the British Association, which last year celebrated its fiftieth anniversary under the Presidency of Sir John Lubbock. The American Society came after those two in point of age, and after it followed the French Association now about ten years old, and which last year met away out in the heart of Africa, where it numbered upward of a thousand members. Our own American Association began as an association of geologists and naturalists in 1842, the speaker joined it in 1845. Its inception was thus independent of the British Association for the Advancement of Science, but the leaders of the latter body led the American scientists to recast their association and give it the name it now holds. This was done at Philadelphia in 1848, and he boasted of one of the earliest members forming it, of which so few were spared to be with them to-day, and yet it was only thirty-four years ago. There had been an interruption during the civil war, so the Society only counted this as its thirty-first anniversary. The United States and Canada were counted in the great work of science as one. At the time of the Geological Survey many scientific men were attracted to Canada from the other side of line 45°. Prof. Hall had been much associated with the Survey and it was judged proper, in 1857, to have the meeting at Montreal. The late Sir Wm. Logan, then Chief of the work, was Chairman of the Local Committee, and he (Dr. Hunt) acted as Secretary. It was a matter of regret that the duties of the present director of the Survey required his presence in our far western Province. The citizens would be proud to show their guests the Mountain and Island Parks, the Churches, Museum and other points of interest. The Canadian Pacific Railway would convey such as wished to visit Ottawa on Saturday next, where the

Geological Survey and other points of interest could be seen. The Richelieu & Ontario Navigation Company's steamers would take others to Quebec, and on Thursday, the 31st, the South-Eastern Railway would take such as desired to go to Lake Memphremagog. He concluded by saying that their only wish was that all the members of the Association might carry away with them the impression that the citizens of Montreal, one and all, felt the high honor of their visit to the city and would do everything to make their stay in the city as pleasant as possible.

Mayor Beaudry was then introduced and extended the welcome of the city to the members of the Association in graceful and appropriate words.

Dr. Thorburn, of Ottawa, said that a public meeting had been held in that city, and means taken to give a proper welcome to the members of the Association. The capital had many attractions, and he was sure the members would be pleased with their visit.

Dr. Dawson then said,—It falls to me, gentlemen, to acknowledge on behalf of the Association, the welcome with which you have given it. In doing so, I have the advantage of knowing from personal observation the zeal and energy which have been displayed by the members of the local committee, and the enthusiasm kindled by the occasion in the minds of the citizens generally. The occasion is undoubtedly one worthy of the interest it has excited, not only in this and neighboring cities, but in Canada generally. By its selection for the meeting of this Association, Montreal becomes for the time the scientific capital of North America, from which will go forth decrees more potent than those of parliaments, and to which will be turned the eyes of all interested in the progress of Science and the Scientific Arts. You do well to esteem highly the position thus conferred and to sustain it in the future by the actions of your own local institutions.

The fact that we can congratulate ourselves on this occasion in the presence of so many and so eminent men of science from the other side of the Atlantic is due to the exertions of the Local Committee and to the liberality of the citizens of Montreal. I had the honor in 1856 to be the spokesman of a delegation which went to Albany to invite this Association to hold the meeting in Montreal in 1857, which has been referred to. That meeting was a most successful one, though, no doubt, far inferior in numbers to the present. It benefited this Association and the interests of science and gave a stimulus to the cause of scientific education and research in Montreal, the effects of which still remain. May the present meeting be still more agreeable and useful. Of the leading men of science who took part in the meeting of 1857 many have passed away; Henry, Logan, Bache, Pierce, Munro, Billings and Morgan are among these. But many of the men who then stood high in science are with us to-day, and you now welcome a large number of men who have since that time risen into eminence, and of still younger men whose names will yet be widely known. To such young and rising men you should, and I know do, extend a welcome as hearty as to those who are their seniors and are better known to you. You welcome here to-day a much larger body than that which you received in 1857. This is evidenc-

ed not only by the larger number of members, but by the increased number of sections. In 1857 there were two sections and a sub-section. Now there were no less than nine sections meeting simultaneously. I have only to add, on behalf of the Association, that the ordinary meetings of the sections, and those evening meeting addresses which will be advertised, are open to all who may desire to benefit by them; and that the membership of the Association is open to all suitable applicants on very easy terms. Such entertainments and excursions as have been provided by the Local Committee or by local institutions and private individuals, are of course limited by the invitations they may issue, but I have no doubt they will be made as extensive as the circumstances will permit. Dr. Dawson also read a letter from His Excellency the Governor-General regretting his absence.

The Permanent Secretary, Prof. F. W. Putnam, stated that the financial report of the year had been printed. A large number of donations had come in for reprinting volumes of the past proceedings of the Association, among others one from Gen. William Lilly of $1,000 toward the expense of reprinting Volume XXVI of the Proceedings, and since he had come to Montreal he had received another contribution of $150 for the same purpose. Some 160 papers had already been entered for this meeting and referred to the various sections.

Dr. Hunt announced that the promenade in the Art Gallery would take place on Monday evening, after Prof. Bell's lecture, instead of on Tuesday evening as announced. He expressed regret at the absence of the Hon. Justice Mackay, President of the Art Association.

DECEASED MEMBERS.

Prof. Putnam then read the following list of members reported deceased since the last meeting of the Association, viz:—Zachari Allen, Providence, R. I.; J. G. Barnard, New York City; Geo. L. Blackie, Nashville, Tenn.; Albert H. Briggs, Springfield, Mass.; Mrs. Mary H. Campbell, Crawfordshire, Ind.; Frederick Collins, Washington, D. C.; J. M. Crank, Wolfeville, N. C.; Charles F. Crocker, Lawrence, Mass.; E. A. Dalrymple, Baltimore, Md.; Caleb G. Forslier, New Orleans, La.; J. Goldsmark, New York; Geo. W. Hawes, Washington, D. C.; Thos. Potts James, Cambridge, Mass.; Lewis H. Morgan, Rochester, N. Y.; Chas. H. Payne, Saratoga Springs; J. Duncan Putnam, Davenport, Ia.; W. B. Rogers, Boston, Mass.; E. Root, Amherst, Mass.; W. Sheppard, Drummondville P. Q.; David P. Smith, Springfield, Mass.; Chas. Spenzig, St. Louis, Mo.; A. R. Thompson, New York; W. S. Vaux, Philadelphia; J. C. Watson, Ann Arbor, Mich.; Mrs. G. O. Welch, Lynn, Mass.

NEW MEMBERS.

The General Secretary, Mr. W. Saunders, then announced that the Standing Committee recommended for membership the gentlemen forming the Local Committee and 169 other applicants, who, on motion, were duly elected members of the Association.

On the suggestion of the President, the English and European scientists attending the meeting were elected members of the Association.

President Dawson announced that the annual meeting of the British Science Association opened on the same day as this meeting, and suggested that a message of greeting and congratulation should be cabled to it from the American Association, a suggestion that met with the approval of those present.

The meeting was then declared adjourned, and the Association resolved itself into the various sections which met in their respective apartments for organization. The proceedings were the same in all of these sections, and consisted of the election of one Fellow from each section to represent it on the Standing Committee during the ensuing year; also, the election of the Sectional Committees, which are composed of three Fellows from each section together with the Vice-President and Secretary, and which select the papers to be read and make other arrangements for the meetings of the sections respectively; the election of the Nominating Committee, composed of one member or Fellow from each section; the election of three members or Fellows from each section, to act with the Vice-President and Secretary of that section as a sub-committee to recommend to the Nominating Committee, the Vice-President and Secretary of such section respectively for the next meeting of the Association.

EVENING PROCEEDINGS.—THE RETIRING PRESIDENT'S ADDRESS.

Notwithstanding the inclemency of the weather the spacious Queen's Hall was completely filled on the occasion of the public address of the retiring President of the Association, Prof. George J. Brush, of New Haven, Conn. Among the audience was a large representation of the *elite* of Montreal. The new President, Dr. Dawson, occupied the chair, and on the platform were the past Presidents, the present Vice-Presidents and invited guests.

PROGRESS OF AMERICAN MINERALOGY.

Prof. Brush's address consisted of a sketch of the progress of American Mineralogy, of which the following is a condensed report:

After remarking that the change in the constitution of the Association effected at its last meeting had relieved the retiring President from attempting a general review of the progress of science during the past year, he said: During the last quarter of the eighteenth century, while great activity existed and rapid advance was made in the study of chemistry and mineralogy in Europe, almost nothing was accomplished in this new country. It is true that students in other departments of science, especially members of the medical profession, in the cities of Philadelphia, New York and Boston, attempted to arouse an interest in mineralogy, believing that the diffusion of a knowledge of this science would be of the utmost importance in the material development of the country. There were, however, no text books to aid the inquirer. There were no collections of minerals to stimulate the student. In the absence of these it was almost impossi-

ble that an interest in this science should be fostered, or that a spirit of investigation should be awakened.

As the first distinct beginning of the science, I may mention an association formed in 1798 in the City of New York, which assumed, as they expressed it, "the name and style of the American Mineralogical Society." It announced as its object "the investigation of the Mineral and Fossil bodies which compose the Fabric of the Globe, and more especially for the Natural and Chemical History of the Minerals and Fossils of the United States." The distinguished Dr. Samuel Latham Mitchell, who seems to have been a man of universal genius, was at once its first President, its Librarian, and its Cabinet-keeper. The committee of the society issued a circular in which, while expressing themselves, "desirous of obtaining and diffusing by every means in their power a correct and extensive knowledge of the mineral treasures of their country, they earnestly solicited their fellow citizens to communicate to them on all mineralogical subjects, but especially on the following, viz:

1. "Concerning the stones suitable to be manufactured into *gun-flints;* where are they found? and in what quantity? 2. Concerning *native brimstone or sulphur* or the waters or minerals whence it may be extracted? 3. Concerning *saltpetre:* where (if at all) found native? or the soils which produce it in the United States? 4. Concerning mines and ores of *lead:* in what places? the situation? how wide the vein? in what kind of rock it is bedded."

This warlike demand seems to call more for the discovery of the materials for national defense than for the advancement of science, and besides being a commentary on the spirit of the times, gives a rather humorous impression of their strangely inadequate conception of the science of mineralogy, and its possible bearings on practical life. But in justice to them I should add that it is further announced that "specimens of ores, metals, coals, spars, gypsums, crystals, petrifactions, stones, earths, slates, clays, chalks, limestones, marbles, and every fossil substance that may be discovered or fall in the way of a traveller, which can throw light on the mineralogical history of America, will be examined and analyzed without cost; sufficient pieces, with the owner's leave, being reserved for placing in the society's collection." I have quoted the circular almost verbatim to give you some idea of the genuine though crude longing for knowledge felt by our early mineralogists, and also of the generous spirit in which they worked.

A still more forcible picture of the ignorance of the time is given by the elder Professor Silliman in 1818. "Notwithstanding the laudable efforts of a few gentlemen," he says, "to excite some taste for mineralogy, so little had been done in forming collections, in kindling curiosity and diffusing information, that only fifteen years since (1803) it was a matter of extreme difficulty to obtain *among ourselves* even the *names* of the most common stones and minerals."

Such, then, was the state of knowledge in mineralogy here at the commencement of the century. A few American minerals, collected by travelers from time to time, had before this been taken to Europe for identification, but among

these were discovered only two minerals new to science. The Moravian missionaries found at St. Paul, in Labrador, the beautiful species of feldspar called by Werner *labrador-stein*, which in more modern times we know under the name of *labradorite*. Klaproth, the most eminent analytical chemist of his time, discovered that the so-called fibrous barytes from Pennsylvania was the sulphate of the then newly-discovered earth strontia. He thus, for the first time, identified the mineral species *celestite* which was subsequently found in various localities in Europe.

Although little had been accomplished in America previous to 1800, the first quarter of the new century was destined to show great development here in the study of mineralogy. During the early years of this quarter several collections of European minerals were brought to this country by American gentlemen who had availed themselves during a residence in Europe of the best opportunities for acquiring a knowledge of the science from the great masters of the subject in Germany and France. About this time also several colleges in the country had instituted chairs of chemistry and mineralogy, and a commencement was thus made in teaching these sciences in the higher schools. As the result of these influences the number of persons interested in mineralogy was largely increased, and an active search for minerals was initiated throughout all of the older United States and to a considerable extent also in Canada.

So energetically were these explorations followed up that in 1825 a catalogue of American minerals was published by Dr. Samuel Robinson, with their localities arranged geographically, and giving only such as were known to exist in the United States and the British Provinces. It formed an octavo volume of over three hundred pages.

That much credit was due to *many* workers during this period, both in the field and in the laboratory, there can be no question, but among them all I find four men standing forth so prominently as leaders, that I have thought it would be well for us to recall briefly something of the character of these men and their labors for the advancement in mineralogy in this country. These mineralogists were Dr. Archibald Bruce, who was born in New York in 1777 and graduated at Columbia College; Colonel George Gibbs, of Rhode Island; Professor Parker Cleveland, of Bowdoin College, and Professor Benjamin Silliman, late Professor of Chemistry, Mineralogy and Geology in Yale College. After sketching the labors in this branch of science of these eminent pioneers, the lecturer went on to say that it will be inferred that the developments and discoveries of minerals, during the first twenty-five years of the century, were due entirely to individual enthusiasm and private enterprise. Up to this time no aid had been received from either State or National governments, and in looking over the work accomplished during this period we are filled with wonder and admiration at the energy and rare devotion to science exhibited. The larger portion of the continent was an unbroken wilderness, and the facilities of communication even in the settled parts of the country were of the most primitive character. Yet at the present

day, with our means of rapid transportation, many naturalists would hesitate to undertake the long journeys then made for purely scientific purposes.

The public mind was finally awakened to the importance of the work which these explorers and investigators had carried on single-handed. Government now came to the aid of Science. In 1824, one State Legislature, that of North Carolina, authorized a geological survey to be made. This example was followed in 1830 by Massachusetts and soon after by New York, Pennsylvania, Virginia and other States, and also by the national Government, until as is now well known, the whole territory of the United States and Canada, either has been or is in the process of being surveyed. Several of the State surveys published independent volumes on the mineralogy of their respective States, and these surveys have been a powerful auxiliary in extending our knowledge of the occurrence of minerals on this continent. The opening of mines and quarries throughout the country has also furnished abundant material for study.

Proceeding to call attention to some of the developments made in the field in which American mineralogists have worked, he said: It was thought by many scientists in the first half of this century that our rocks seemed likely to afford less variety of mineral contents than the rocks of Europe. Further study, however, and more careful and extended observations encourage us to believe that our mineral riches, even in variety of species, will compare favorably with those of other continents. Already fully one-half of the known mineral species have been found here. The present number of known minerals is variously estimated to be from seven hundred to one thousand. There have been described, as occurring here, nearly three hundred supposed new American minerals. Of these, perhaps one-quarter are new to science and the remainder have either been proved to be indentical with species already described, or their characters are so imperfectly given that further investigation is needed to ascertain what they are.

After speaking particularly of some of these new minerals of most interest to science, he observed:—While the service done for mineralogy by our geological surveys is gratefully acknowledged, we feel we have a right to demand much more from them in the future. Mineralogy has been too largely looked upon as a guide to the discovery of useful ores and minerals and not as a matter for scientific study; fortunately during the past decade the discoveries in optical mineralogy, and their importance in the determination of the constituent minerals of the crystalline rocks, have led many geologists to again recognize the desirability of a knowledge of our science. Much will be accomplished if those in charge of geological surveys will direct competent persons to make observations, not only on the main mineral constituents of rocks but also on the manner of occurrence of individual minerals. The careful inspection of quarries and mines is greatly to be desired.

It is too true that many of the most interesting discoveries already recorded seem to have been due more to the result of fortunate accident than of systematic and intelligent exploration. If our trained mineralogists, instead of devoting most of their attention to the examination of specimens in cabinets collected by

others, would give more time to personal observation in the field in the study of the order and manner of occurrence of mineral species in place, our knowledge would doubtless be greatly promoted. Again, if our wealthy amateurs could be induced to spend their money as freely in the exploration of promising American localities as in the importation of costly European specimens, we might hope for many important discoveries, and they could have the satisfaction not only of gaining novelties for their collections, but incidentally they would do much to foster science.

In order to keep pace with the progress of the science, we need many more workers who will devote themselves especially to mineralogical research, and we need more of the spirit of the early workers. It is my belief that the number of persons at present interested in the study here, either as amateurs or investigators is relatively less than in 1825. The mineralogy of to-day is a very different subject from the mineralogy of the commencement of the period over which we have so hastily glanced.

ORGAN RECITAL.

Immediately after the close of the address Dr. Davies gave an organ recital that had the effect of detaining a large number of musically inclined persons in their seats. The following programme was rendered in masterly style:

1—Romansa, for violin and organ . . . . . Beethoven.
2—Andante Cantabile from Concerto Op. 64. . . . . Mendelssohn.
3—Selection from "Carmen" . . . . . Bizet.
4—Andante and Scherzo "Reformation" Sy . . . . . Mendelssohn.
5—March et Cortege, "Irene" . . . . . Gounod.

At the conclusion, by general request, Dr. Davies played a selection of national airs, winding up with God Save the Queen.

THE RECEPTION.

In the meantime the delegates, and such as had received cards of invitation, flocked into the assembly room, to attend the reception extended to the members of the Association by the local committee. Across the end of the spacious apartment was extended a refreshment table, where cooling ices and lemonade were dispensed by active waiters. The lamps were draped with rose-colored shades, softening the glare and adding to the general effect. There were a large number of ladies present in elegant costumes, most of the citizens present having brought their wives, and for a while introductions were going on in every part of the room. As soon as the ice was broken, the hum of conversation, continually broken by gay laughter, was incessant, and abstruse subjects seemed for a while to be abandoned for the novelty of trivial tropics.

Among the citizens present were Sir Francis Hincks, W. S. Consul-General Stearns, Reverend Principal Henderson, Dr. Howard, Aldermen Mooney and Kennedy, G. W. Stephens, Dean Baldwin, Canon Ellegood, Rev. Robert Campbell, Peter Redpath, D. A. Ansell, Louis Lesage, John Stirling, J. H. Joseph, Thomas Workman, T Sterry Hunt, Professor Johnson, Rev. Dr. Stevenson, Dr.

Hingston, S. E. Dawson, Alex. Buntin, G. A. Drummond, Dr. Scott, John Kennedy, Hugh McLennan, W. B. Lewis, J. J. Maclaren, Q. C., John Lovell, Richard White, W. O'Brien, D. Morrice, R. A. Ramsay, W. Angus, G. B. Burland, J. A. U. Baudry, T. Foster Bateman, W. Taylor, T. D. King, Dr. Trenholme, Dr. Turgeon and others.

The reception lasted about an hour, after which the company began to disperse.

PROCEEDINGS OF THE SECTIONS.

We are gratified to be able to give to our readers in the following pages a very full report of the proceedings of the several sections, with pretty complete and accurate abstracts of many of the best papers read, an account of the excursions participated in by the members, and many other items of interest that will probably not be found in any other journal of this class.

We are indebted to Professors Putnam, Mason, Lovewell, Bassett and Ward, Rev. H. C. Hovey and to Mr. Cook of the Montreal *Star*, for material furnished and attentions rendered, and we shall remember with pleasure the brief personal intercourse had with Principal Dawson, of McGill University, Dr. John Rae, of London, Prof. H. C. Bolton, of Hartford, and others who had in the past contributed articles to the REVIEW, but whom we had never met before.

ASTRONOMY.

TRANSIT OF VENUS.

Section A met in the Wm. Molson Hall, to hear the reading of a paper on "The Transit of Venus," by Prof. J. R. Eastman. The author of the paper is Mr. Wm. Harkness, the Chairman of the Section, who was unavoidably detained at Washington on important business. The paper went on to say that transits of Venus usually occur in pairs, the two transits of a pair being separated by only eight years, but between the nearest transits of consecutive pairs more than a century elapses. We are now on the eve of the second transit of a pair, after which none other will occur till the twenty-first century of our era has dawned upon the earth, and the June flowers are blooming in A. D. 2004. When the last transit season occurred, the intellectual world was awakening from the slumber of ages, and that wondrous scientific activity which has led to our present advanced knowledge was just beginning. What will be the state of science when the next transit season arrives, God only knows. Not even our children's children will live to take part in the study of the astronomy of that

day. The scientific history of past transits was then noticed at length. When the Ptolemaic theory of the solar system was in vogue, astronomers correctly believed Venus and Mercury to be situated between the earth and Sun, but as these planets were supposed to shine by their own light, there was no reason to anticipate that they would be visible during a transit, if indeed a transit should occur. Yet singularly enough, so far back as 807, Mercury is recorded to have been seen as a dark spot upon the face of the Sun.

We now know that it is much too small to be visible to the naked eye in that position, and the object observed could have been nothing less than a large Sun-spot. Upon the establishment of the Copernican theory it was immediately perceived that transits of the inferior planets across the face of the Sun must occur, and the recognition of the value of transits of Venus for determining the solar parallax was not long in following. The idea of utilizing such transits for this purpose seems to have been vaguely conceived by James Gregory or perhaps even by Horrocks, but Halley was first to work it out completely, and to him is usually assigned the honor of the invention. His paper published in 1716 was mainly instrumental in inducing the Governments of Europe to undertake the observations of the transit of Venus in 1761 and 1769, from which our first accurate knowledge of the Sun's distance was obtained. When Kepler had finished his Rudolphine tables, they furnished the means of predicting the places of the planets with some approach to accuracy, and in 1627 he announced that Mercury would cross the face of the Sun on November 7, 1631, and Venus on December 6th of the same year. The intense interest with which Gassendi prepared to observe these transits can be imagined when it is remembered that hitherto no such phenomena had ever greeted mortal eye. He was destitute of what would now be regarded as the commonest instruments. The invention of telescopes was only twenty years old and a reasonably good clock had never been constructed. His observatory was situated in Paris and his appliances were of the most primitive kind. By admitting the solar rays into a darkened room through a small round hole, an image of the Sun nine or ten inches in diameter was obtained upon a white screen. For the measurement of position angles a carefully divided circle was traced upon this screen and the whole was so arranged that the circle could be made to coincide accurately with the Sun. To determine the times of ingress and egress, an assistant was stationed outside with a large quadrant, and he was instructed to observe the attitude of the Sun whenever Gassendi stamped upon the floor. Modern astronomical predictions can be trusted within a minute or two, but so great did the uncertainty of Kepler's tables seem to Gassendi, that he began to watch for the expected transit of Mercury two whole days before the time set for its occurrence. On the 5th of November it rained, and on the 6th clouds covered the sky almost all day. On the 7th toward nine o'clock the Sun because distinctly visible, and turning to its image on the screen the astronomer observed a small black spot upon it. He at first took it to be a Sun-spot, and shortly he was surprised to see it had suddenly disappeared. After continued observation Gassendi concluded, as he saw the spot on the Sun move, that it was really the

planet, and he called upon his assistant to mark the Sun's attitude, but that individual had deserted his post, and it was only within a few minutes before its going down, and in spite of the unfortunate circumstances, that an important addition was made to our knowledge of the motions of the innermost planet of the solar system. Although successful in observing Mercury Gassendi was deprived of the pleasure of seeing the transit of Venus, as it took place in the night. Transits of Venus can occur only in June and December, and as the two transits of a pair always happen in the same month, if we start from a June transit the intervals between consecutive transits will be eight years, one hundred and five and a half years; eight years, one hundred and twenty-one and a half years; eight years, one hundred and five and a half years, and so on. This is the order which exists now. The path of Venus across the Sun is not the same in the two transits of a pair. For a pair of June transits, the path at the second one is sensibly parallel to, and about twenty minutes north of, that at the first, while for a pair of December transits the parallelism still holds, but the path of the second one is about twenty-five minutes south of that of the first. The paper went on relating all the efforts made by Lansberg, the Belgian astronomer, and others, and the fact that about the most valuable information on the subject had been discovered by Horrocks, a young curate of twenty, who resided near Liverpool in 1631. The years sped rapidly by, and as the transit of 1761 approached, Halley's paper of 1716 was not forgotten, but his plans were taken up and discussed. Delisle was the first to point out the exact conditions of the transit and the circumstances upon which the success of the observations would depend. The Sun causes Venus to cast a shadow which has the form of a gigantic cone, its apex resting upon the planet and its diameter continually increasing as it recedes into space. All the phenomena of transits are produced by the passage of this shadow cone over the earth, and as each point of the cone corresponds to a particular phase of a transit, any given phase of a transit will encounter the earth and first become visible at some point where the Sun is just setting, and will leave the earth and therefore be last visible at some point where the Sun is just rising. Between these two points it will traverse nearly half the earth's circumference and in so doing will consume about twenty minutes. The transit of 1761 was visible throughout Europe and was well observed by astronomers. England sent expeditions to St. Helena and to the Cape of Good Hope; and English astronomers observed at Madras and Calcutta. French astronomers went to Tobolsk, Rodriguez and Pondicherry, and Russians to Tartary and China, and Swedes to Lapland. No less than 117 stations were occupied by 176 observers, and of these 137 published their observations. The various experiences of several astronomers were then fully discussed and the transit of 1882 was referred to. Astronomers met in Paris last year from Europe, and after discussion the system of photography, which had been suggested, was condemned as being useless. The United States were not represented at this conference and therefore the experience from America was not obtained. He then referred to the efforts which were being made by the United States Transit of Venus Commission in this regard, and

thought that they favored the photographic system. He hoped that the astronomers in America would do all their duty in the matter in the interests of posterity.

EVOLUTION OF THE EARTH.

Rev. Samuel Haughton, D. D., Fellow of Trinity College, Dublin, read a paper Monday morning in Section A on "New Views of Mr. George H. Darwin's Theory of the Evolution of the Earth,—Moon System, considered as to its Bearing on the Question of the Duration of Geological Time." He said: It has been tacitly assumed, even so far back as the times of Newton and Clairvant, that the earth and planets have passed through a liquid condition (owing to former great heat) before assuming this solid condition which some (at least) of them now possess.

Laplace, in his nebular hypothesis, also assumes the former existence of this liquid condition, and it is openly assumed by all geologists who believe that the earth consists of a solid crust (more or less thick) reposing upon a fluid or viscous nucleus.

It has been asserted by Sir William Thompson, following out the views of the late Mr. Hopkins, that the present condition of the earth taken as a whole, is such that it must be regarded as being more rigid than glass or steel, probably more rigid than any terrestrial substance under the surface conditions of pressure. The following conditions show that it may be fairly douted whether the earth or any planet ever existed in liquid conditions.

1. The possibility of the equilibrium of the rings of Saturn, on the supposition that they are either solid or liquid has been more than doubted, and the most prbable hypothesis respecting them is that they consist of swarms of discrete meteoric stones.

2. It is difficult to understand the low specific gravity of Jupiter and the other outer planets, on the supposition that they are either solid or liquid, for we know of no substance light enough to form them. The force of this argument could not be felt before the revelations of the spectroscope, because at that time there was no proof that the whole universe was composed of the same simple substances, and those very limited in number. If the outer planets consist of discrete meteoric stones, moving around a solid or liquid nucleus, the difficulty respecting their specific gravity would disappear.

3. The recent researches connecting the November, the August and the other periodic swarms of shooting stars with comets tend in the direction of showing that comets in cooling break up into discrete solid particles, each no doubt having passed through the liquid condition , and that probably the solar nebula cooled in like manner into separate fiery stars, which soon solidified by radiation into the cold of space.

4. Mr. Higgins' recent comparisons of the spectroscopic appearances of comets and incandescent portions of meteoric stones, showing the presence in

both of hydro-carbon and nitrogen compounds, confirm the conclusions drawn from the identity of the paths of comets and meteoric-periodic shooting stars.

5. Mr. H. A. Newton, in a remarkable paper read before the Sheffield meeting of the British Association, 1879, showed the possibility (if not the probability) of the asteroids being extinct comets, captured and brought into the solar system by the attraction of some one or other of the outer large planets, and permanently confined in the space between Mars and Jupiter, which is the only prison cell in the solar system large enough to hold permanently such disorderly wanderers.

In the same paper, Prof. Newton threw out the idea that some of the satellites of the large planets might also be of cometary origin. From all these and other considerations, it is therefore allowable to suppose that the earth and moon when they separated from the solar nebula, did so as a swarm of solid meteoric stones, each of them showing the temperature of interstellar space; *i. e.*, something not much warmer than 460° F. below the freezing point of water.

Mr. George H. Darwin has shown admirably how the earth-moon system may have been developed from the time when the earth-moon formed one planet, revolving on its axis in a few hours to the present time, when the earth and moon (in consequence of tidal friction) have pushed each other asunder to a distance of sixty times the radius of the earth. Dr. Haughton then entered into a lengthy and most careful study of his paper, and il ustrated it on the blackboard. He concluded by saying that the remarkable expression found by Mr. Darwin is not peculiar to his special hypothesis of a viscous earth, but can be deducted equally well from the totally distinct hypothesis of an absolutely rigid earth retarded by the tidal action of a liquid ocean.

PHYSICS.

INSTRUCTION IN PHYSICS.

In this section Vice-President Mendenhall read a paper on "Instruction in Physics," of which the following is a synopsis:

Out of respect for sciences as old as science itself, we have freely accorded the first rank, as far as a designating letter may be able to imply it, to our veteran co-laborers, the mathematicians and astronomers. This separation of physics from astronomy and mathematics, as well as from chemistry, mechanics, etc., must be considered as temporarily convenient for the purpose of specializing the powers of the Association. We were mistaken in supposing that science had only advanced through contributions—the result of original research in our laboratories and libraries; even were so narrow a view taken, the existence of such

an atmosphere would in itself be a blessing, as fostering a love for research whereby talent was fostered.

It was desirable to bring about a more accurate knowledge concerning the elementary principles and propositions of the science of physics for general diffusion among the masses of educated people; this diffusion was not now taking place to any great extent. The subject, considered as a whole, naturally divided itself into two parts, pertaining respectively to higher, and elementary instruction. A few keen-sighted men, combining in themselves happily the student and the teacher, recognized the fact that thorough instruction in physics demanded the use of laboratory methods, such as had been utilized for some years in chemistry, and were rapidly coming into prominence in every department of natural science. Among these was notable that of Professor Pickering, whose establishment for purposes of instruction at Boston must be regarded as an epoch in the history of this progress. With that also might be linked, though coming at a little later date, the well known establishment of Professor Mayer at Hoboken. A report on the teaching of Chemistry and Physics in the United States by Professor Clarke, of Cincinnati University, was recommended to all interested in the study of the present condition of this work. Professor Clarke classified the various courses as follows:—1st. Full course, including higher mathematical physics, advanced laboratory work and research. 2d. Full course, with mathematical physics and elementary laboratory work. 3d. Course in general physics, involving a previous knowledge of trigonometry and including laboratory work.

The other courses, ten in number, are elementary.

The report contained statistics from nearly four hundred universities, colleges, agricultural colleges, and schools, scientific or otherwise; out of the whole number, there were thirty-three institutions where the instruction in physics fell within the limits established above. Of these, four were of the first rank, two of the second, and twenty-seven of the third.

A great teacher has told us that we studied nature in books, and when we met her face she passed unrecognized. There sprang up a new method, the use of the text book fell into disrepute, it was as if all men were to cast aside their maps, globes, histories, books of travel, etc., and start out to obtain a knowledge of the world by visiting its different portions. The underlying principle of the new method was correct, but it was a mistake to give it unrestricted application.

The course of study in physics for the undergraduate collegian should include a sufficient training in mathematics to enable him to apply his knowledge with ease and facility to the more common physical problems; a thorough and exacting course of text book and lecture work, to be supplemented by a course in the laboratory in which greater attention should be paid to the quality rather than quantity of the work done. There was great need of reform regarding instruction in physics in the school; although American text books were numerous, none have properly combined in their making the experience of the class-room with the critical knowledge of the scholar; text books, it was true, might be imported from Europe, and they in the main were vastly superior to our own, but

even these failed to supply the need; co-operation was required, this might be accomplished through the National Educational Association.

PROF. BELL'S INSTRUMENT FOR DETERMINING THE LOCATION OF BULLETS IN THE HUMAN BODY.

Section B held its meeting this morning in the William Molson Hall, the large room being taxed to its utmost capacity with members of the Association eager to hear Prof. Alex. Graham Bell's paper upon the electrical experiments to determine the location of the bullet in the body of the late President Garfield; and upon a successful form of inductive balance for the painless detection of metallic masses imbedded in the human body. Prof. Bell being introduced to the mee ing said that the subject he had chosen for his paper recalled the time of excitement and painful suspense attending the time when the chief executive of the United States lay nobly bearing prolonged suffering, and all the world watched by his bed, and hoped and feared. In cases similar to that of the late President, the great object was to find the location of the bullet. In the past the only way in searching out a bullet was by probing with the knife and lance among tender tissues and in fatal points. Science in the position it held at the present day could surely do something to replace these barbarous operations, and to see if something could not be done to prevent this dangerous system of roping among quivering muscles he applied himself to work.

The same problem had been considered by Professors Newcomb and Hopkins. It was perhaps natural for him as an electrician to attempt to apply electricity to the solution of the problem and for him personally to resort to the telephone. The idea he had was that the question could be satisfactorily solved by the joint use of the telephone and the induction balance. At the time he set to work on this problem he had in his mind the result of some investigations he had conducted in England. He exhibited several modifications of the induction balance, which he described as two electric coils connected and at some distance apart. He read in the newspapers of some experiments which had been made by several electricians to determine the presence of the metals, the results of which were that it was found that a magnetic needle in motion is retarded in its rotation by being passed over copper bodies. When the President was shot he immediately opened a series of investigations with the magnetic needle, and he found that a disc of lead brought under a revolving magnetic needle caused a deviation of it. A bullet, however, had no noticeable effect on the needle. His investigations in that way were consequently given up and he set to work with the induction balance. He connected a telephone with one pole of an induction balance and when the other came in contact with or near to a metallic body, a perfect battery being formed, an electric current was sent through the connections, and a noise could be heard in the telephone. The difficulty was to give

the greatest hearing distance to the telephone, to find an instrument which would cause a sound at the greatest distance possible from the induction balance. He tried several experiments to find a solution to this difficulty, and telegraphed for the advice of scientific friends, both in America and England, but was unable to make an instrument which would pronounce an audible sound with the metal bodies sought for, further than one and a half inches from the induction balance.

He succeeded in perfecting an instrument which allowed a distance between the metal and the balance of five centimetres. In this instrument the primary coil was of a conical shape and the secondary coil fastened on the apex. A very considerable improvement was discovered soon afterward, when, at the suggestion of Professor Rowland, he applied a condenser in the primary circuit. The result was wonderful. On bringing a bullet near the inductor, the telephone emitted a sound resembling a high, shrill whistle; in fact, the condenser appeared to act as a resonator. It was with the instrument in this condition that he made the first experiment with the late President's wound, the result of which had never been published. The instrument on the occasion was out of order, and emitted an uncertain spluttering sound which they could not stop, and consequently the experiment was a failure. He then turned his attention to another system of induction balance consisting of two round plates, one placed over the other and in a wooden case. It was with this instrument that he made the second experiment with General Garfield on August 1st. The trouble with this instrument was that the slightest motion caused a deflection in the plates, giving a continuous sound in the telephone. The instrument was so delicate also that the chandeliers and iron fire-place in the room affected it. On passing the instrument over a portion of the body above the thigh a distinct sound was heard, and although the instrument was raised a foot above this area it was affected, although not the same extent as when it was closer to the body. Subsequent events proved that the bullet was not lodged in that area and he could only account for the action of the instrument by the fact that the patient lay on a steel wire bed. The difficulty in the instrument of the movement of the plates was effectively removed by imbedding them in a mass of paraffine, and this is the instrument as perfected and with which the bullet was discovered in the body of civil war veteran. He was still pursuing his investigations and hoped yet to bring the instrument to a much greater state of efficiency.

A modification of the instrument, in which the plates were in a hoop large enough to pass over the limbs for determining the location of bullets lodged in the extremities, he exhibited. In concluding, he said that lead was the metal of all for acting with electric apparatus and warmly expressed the wish that in future bullets should be made of silver or iron. His work in this direction had been purely a labor of love, and he could not have had a higher inducement than working to alleviate sufferings.

COLOR BLINDNESS.

Prof. E. L. Nichols, of Richmond, Ky., read a paper on the duration of color impression upon the retinr. The essayist, by a modification of the method of Plateau, had determined for six different portions of the spectrum, the rate of revolution which must be imparted to a disc, with several narrow open sectors, in order to produce an unbroken visual image of the spectral region viewed through the disc. The rate of revolution which may be taken as a measure of persistence of vision was found to be a fraction of the wavy length, and of the intensity of the ray. The results of the experiment described may be represented by a series of curves with wave lengths as apeses and duration of the impression upon the retina as ordinates. These curves show a certain vision flance to the curves for the relative luminosity of the different spectral regions, as measured by Francis Hofer, Herordt and Hood. The way in which the two curves differ is such as to suggest that these measurements are not efficient to prove that perhaps the duration of impression is inversely proportioned to the luminosity. The difference between the curves was in the higher values for the more refrangible rays; in the curve for the duration of impression. This curve corresponds of necessity to a very faint spectrum. The change which the curve for luminosity would undergo, were the intensity of the ray decreased, would, owing to the greater activity of the violet nerves of the eye at less intensities, cause that curve to approach much more nearly, if it did not coincide with, the curve for duration of impression. It was also found that the curve differed greatly in the case of different observers, and to a less degree from time to time for the same eye. The interval of darkness which may be allowed to intervene between exposures of a given duration, without interfering with the apparent continuity of vision, and its variation when the length of exposure varied, was also determined. The exposure varied from 12-1000 second to 786-1000 second, and the interval of darkness was found to vary, but in less degree.

Prof. Stevens said that the results of Prof. Nichol's investigation were of the greatest importance, as the scientific men of the world who have so long been anxious to form a theory on the question of color blindness have by it been directed to a course of investigation which promised to settle the question.

THE DIATONIC SCALES.

The next paper was by Dr. P. H. Vander Weyde, on the diatonic scale, obtained in the chromatic scales of equal temperament of 12, 19 and 31 tones in the octave, with exhibition of novel scale indicators and correcting key-board, seemed to be of the greatest interest to the ladies present. The essayist maintained that in our common tonal system of twelve tones in the octave for the so-

called chromatic scales of seven tones fitted into the diatonic scale, and from sensitiveness, one between each of the whole tones, the fifths are impure, being a little too low, but the thirds are much out of time, being considerably too high. Another system is possible of nineteen tones in the octave, thus giving besides the seven tones of the diatonic scale twelve other tones, of which two fit between each of the five whole tones and one between each of the two semi-tones. This system gives, however, results inferior to that in use by calculation. When, however, we divide the octave into thirty-one equal parts we obtain four tones between each of the five whole tones and two between each of the two semi-tones, which gives with the seven tones of the diatonic scale thirty-one tones. This system will give also pure thirds and also fits exactly in the adopted system of rotation.

CHEMISTRY.

CHEMICAL LITERATURE.

Chemical Literature, by Dr. H. C. Bolton. He traced the history of chemical literature from the earliest known manuscripts to the beginning of this century, described the characteristics of minor works at different epochs, the discoveries they chronicled and their influence on contemporaneous science.

He dwelt briefly upon the chief works of the Arabians, who a thousand years ago defined chemistry as "the science of combustion, the science of weight and the science of the balance."

In the middle ages literature and science were cast in an ecclesiastical mould. Scientific treatises were the production of monks, and emanated from cloisters. Among the distinguished philosophers who mastered widely separated branches of learning and wrote treatises which 300 years ago were regarded as masterpieces of science, and formed the text books of students of alchemy, should be named Alain de Little, Roger Bacon, Raymond Lally and Albertus Magnus. The collected works of the last named fill twenty-one folio volumes. In the sixteenth century alchemists began to publish the results of their study and industry, with the natural consequence that in the succeeding century a prodigious number of alchemical works were issued in Germany, France and England; some recorded valuable experiments, but the majority contained "a crude mass of incoherent propositions and wild assertions, a mixture of poesy and insanity," all combined to produce literary monstrosities as fascinating to the student of chemical history as they were profitless to the practical worker in modern science. After noticing a large number of works on chemistry and kindred subjects published between the years 1600 and 1700, the opening of a public laboratory for instruction at Altdorf, Bavaria, under the direction of Prof. J. H. Hoffmann, and in the same

year a similar institution at Stockholm under the guidance of Urban Hiurne, were referred to. Lexicons and dictionaries early became a feature of chemical literature, the early Greek MSS. contained "vocabularies of the sacred art." The dissemination of the views of Lord Bacon about the middle of the seventeenth century, gave a great impulse to scientific investigation and the "splendid fiction of the new Atlantis," was practically realized in the foundation of the "Royal Society for improving natural knowledge." After referring to the learned men who, in 1645 forced from London to Oxford by civil war, there laid the foundations of an edifice destined to rise higher, endure longer and to shelter a nobler offspring than the most sanguine could have foreseen, mention was made of some of the earliest periodicals devoted to chemistry.

The modern period of chemistry was characterized by the opposing forces, a tendency to dispersal and an effort to collect the widely scattered publications. On the other hand, laborious authors collected and set in order this dispersed material forming massive hand-books too wieldy for use. In this connection he wanted to bring a matter of the utmost importance to the attention of the meeting. It was the question of compiling an index of the various works of chemistry, tracing its course from its rise in Egypt to the present day. He had attempted to show in his address how interesting a study the history of chemistry was to the students of the science and in fact that it was absolutely necessary that the thorough chemist should have a knowledge of it and be familiar with the theories which were discussed centuries ago. Time and time again the necessity of preparing an index had been discussed, but nothing done.

The applause with which the address was received having subsided, Prof. Arthur Elliott, of Columbia College, suggested that immediate action should be taken, as the matter was of the utmost importance. He consequently moved, and it was unanimously resolved by the meeting, that the Chairman should appoint two of the members to act with himself as a committee to discuss the feasibility of preparing an index.

MECHANICAL SCIENCE.

THE IMPORTANCE OF EXPERIMENTAL RESEARCH IN MECHANICAL SCIENCE.

Prof. W. P. Trowbridge, the Chairman, took for the subject of his annual address "The Importance of Experimental Research in Mechanical Science." He maintained that when Mechanical Science is divested of the subjects in it which have given rise to so much discussion, it is considered by many to have resolved itself into only a few axioms and theorems. So many of the disputed theories being now disproved, and no controversy over the science now going

on, we can hardly help regarding mechanical science as completely understood in all of its branches; and as there is no bright prospect of brilliant discoveries regarding long disputed questions opened out to the young student of Mechanical Science, he does not pursue his investigations with the energy and perseverance which characterized his predecessors. This is not as it should be. The truth is, Mechanical Science is only now beginning to offer itself to men in a state from which they can work with prospects of success, it having had torn from it all of the mistaken theories which hid it from them, and prevented them from putting it to much use. The epoch in which we live has shown marvelous and unexpected results, but there is still open a very wide and promising field of research for the student of Mechanical Science, in the wide range of the arts and engineering. In these days of engineering achievements safety and cost both depend on the knowledge gained by experimental research. He thought it very humiliating for American engineers that in their calculations they had to work on data derived from abroad. Besides this being calculated to bring discredit on America for the want of scientific energy, it was likely to be disastrous in its results in another way. The very condition of things on this continent are different from those abroad, and the material connot be the same, so that the calculations are really made out on wrong hypotheses. This want of experimental research in America should not be charged to the engineers, as they do not possess the necessary and expensive appliances and cannot afford to buy them, besides wanting the requisite time. At any rate he did not very highly estimate researches by private institutions, and he thought it was a reproof to the Governments that they had not taken the matter in hand. All of the data at the disposal of the engineers is half a century old, and they had no accurate data for determining the strength of the new irons and steels, a matter of the utmost importance, when iron is being so largely introduced into the construction of buildings. He considered that the Governments were acting unfairly to the engineers. These gentlemen cannot design without relying on the data they are in possession of as to experimental researches, and although they use their own experience, he expressed the fear that some day some of them would be led astray in their calculations by incorrect data, and bring on themselves ruin. Now steam and hot air were being used so much for heating purposes, he thought it absolutely necessary that there should be some data regarding the capacity of iron piping, but no experiments have been made, and disastrous results may be expected. The world in its march onward will soon demand, in fact, is demanding that something should be done in this direction. There is a movement in the world to overcome all of the obstacles in the way of general progress, and public opinion will have to be accommodated. Stronger ships with machinery that will make them fairly fly through the water will have to be built, powerful engines will have to be designed, which will rush trains along at a speed not now imagined possible, and that over bridges constructed with the least possible expense. This will increase the risks and responsibilities of the engineers, and they will be compelled to ask for public aid. A great work has lately been done by science in sanitary

matters, but most of the investigations have been carried on out of America. He would suggest that the Government should be asked to inaugurate a thorough series of experiments. There would undoubtedly be great trouble in obtaining the services of the right men for the work, as it is on them that the success of the undertaking would depend. Prof. Trowbridge concluded with a highly eulogistic reference to the scientific investigations carried on by Dr. Haughton, of Dublin College, present at the meeting.

AERIAL NAVIGATION PRACTICABLE.

Mr. Joseph L'Etoile, of the Department of the Interior, Ottawa, read a paper on "A Review of the Subject of Atmospheric Current, Electricity and Gases, with a view to Practical Aërial Navigation by means of Balloons." The paper was illustrated with a proposed balloon of fish-like form with a screw at one end and a rudder at the other end. He said that the system of practical ballooning means that a balloon should ascend without loss of ballast and should descend without waste of gas. The balloon of the future should be given the shape of a fish provided with a propeller, a rudder, with gas and air pumps and three gasometers, one for gas, one for air and one for making the change of temperature in the balloon caused by the solar warmth, or moisture in the air, so that by these means the balloonist or aëronaut can control his air-vessel as easily as the engineer his steamboat or locomotive. It is well known that when a balloon shoots up, the gas dilates, the gasometers or gauges tell the changes, and the balloonist adjusts to circumstances. A balloon built on this new plan can ascend or descend slowly, thus giving time to meteorological instruments to mark accurate changes. Charts could be made, and balloonists would know the routes of travel in the air, day and night, at any season of the year. To give an idea of the possibility of establishing those charts, the following may be *apropos*. For instance, a balloon sailing from America to Europe should keep within the lower region, when sailing from Europe to America, it should sail in the high region. Why so? The reason is that cold air is heavier than warm air, consequently the cold Arctic currents prevail in high altitudes especially in the northern Europe and America.

Prof. J. Burkitt gave some explanation as to a new invention which was made in the shape of a steam engine indicator.

AERIAL NAVIGATION.

In section D, Mr. W. H. Lynch read a paper on "The Future of the Balloon as a Practical Means of Aërial travel." He said that the two systems of aërial navigation, by utilizing the flying principle, are quite opposed to each other. In the flying machine the wings or propellers are required to act upon the air to at

once lift the dead weight of the machine, and to propel it or direct its course. The balloon on the contrary, is itself a lifting power, lifting itself and carrying foreign weight that may be a force to direct or propel it. To make fly a machine that is heavier than the air there is needed to merely lift it a greater part, if not all, that it can carry of the weight of force necessary to affect or effect its motion. A machine that is lighter than the air will at least rise of itself and carry more or less surplus weight of force that may be required to make it do something more than merely rise. We do not forget that the self-lifting machine is in one respect at a disadvantage with the inert or dead weight machine. To be lighter than air means to be bulky and to offer in motion great resistance to the air, while what is heavier than air is more compact and its motion more easily caused or directed. This one advantage of the flying machine over the balloon counts, however, but little, so long as it cannot both lift itself and carry the little extra weight of the force required to propel it. The balloon will carry no mean weight besides its own, possibly passenger or freight weight, and the extra weight of a force that may direct or even propel the whole. Strange to say, the principle of the flying machine that has never given any practical results in aerostation, and indeed has given little or no promise of future practical results, seems for some years to have been more in favor of scientists than has been the balloon principle, from which most important, not to say exceedingly promising results have been obtained. When it comes to serious suggestions of possible means of future aërial travel, confidence in science, inventive talent and mechanical skill is lost, and he who is sanguine of the future is by many of the good and wise looked upon as a fit subject for mild ridicule. In answer to the question, from which principle may the best results be expected? we may note that the dead weight principle has given no promise that we shall get from it, alone at least, any practical result. The balloon principle has already given us so much that no one may positively negative the opinion of Glaisher, that it is the "first principle of some aërial machine that remains to be suggested."

The peculiar disadvantage of the balloon, that of bulkiness, may be minimized, and the flying principle itself may doubtless be utilized to its full value in its application to the direction or propulsion of the balloon. There has been almost no progress lately in this matter. The fact that little has been accomplished here, while there has been great advance elsewhere, is taken as a proof that little may be looked for, but we think this a mistaken supposition. The growing interest and faith in the future of aërial travel is well seen by the attention paid lately by scientific journals to the question. As societies for the advancement of aëronautics have been established in Britain, America, France and other countries, there is reason to believe that our knowledge of this most difficult depart ment of science will be more extensive in the near future, and he believed that aërial navigation would yet become a success.

GEOLOGY AND GEOGRAPHY.

REPORT OF PROF. E. T. COX.

Prof. E. T. Cox, Vice President of the section, was formerly Professor of Geology in the State University of Indiana, and removed to San Francisco four years ago, since which he has traveled and made extensive explorations in Arizona, and latterly in Senora, Mexico.

Prof. Cox stated to the section that the labor he had been engaged in during the past four years had been of a character to take him away from practical geological work. For the last year he had been a portion of the time in Mexico, out of reach of all scientific journals and libraries from which to obtain the necessary information to make a regular address such as would represent the progress of geology during the present year, but at the request of the members present he gave them a familiar ex-*tempore* address on the general character of the geology of the Pacific States the mineral deposits of the region, placer gold mining, and gave some account of the anthracite coal field which exists 120 miles east of Guymas, on the Zaqui River, in Sonora, Mexico.

BITUMEN IN THE OHIO SHALE.

Prof. Edward Orton, of Columbus, Ohio, read a paper entitled "A Source of the Bituminous Matter in the Ohio Black Shale." Dr. Orton said that the three beds of bituminous shale of Huron, Cleveland and Newbury have many points of structure and history in common. They are all marine in origin, and they were all formed in quiet waters, and not upon shore lines. They carry from 8 to 22 per cent of organic matter, and this gives them their color and renders them combustible to a more or less degree. There is scarcely a summer in which some of the shale banks of southern Ohio do not take fire. It is this same organic matter obviously to which they owe their character as oil producing shales. They have already been turned to account for the production of oil, and it is scarcely to be doubted that the great stock of carbon which they contain will at some time be utilized by man. This organic matter has been referred both to animal and vegetable sources for its origin, and both of these divisions of the living world have certainly contributed to it. He considered this accumulation of bituminous matter as the result of the growth of sea-weeds in marine basins. In examining in a microscope some borings from a well he found at depths of 996, 1016 and 1044 feet, a number of minute translucent discs, resinous in appearance and unmistakably organic in origin. On examining the black shale

from Columbus, he also found it charged with forms similar, or perhaps identical with these. A number of other organic forms are associated with the spores in the black shale. In fact a flora and fauna of considerable interest are coming to light in these hitherto neglected strata.

After a lengthy discussion the section adjourned.

GEOLOGY AND GEOGRAPHY.

The first paper was by Principal Dawson, President of the American Association for the Advancement of Science, on "The Successive Palæozoic Floras o Eastern North America, and more especially of Canada." The paper gave a sketch of the characteristic species of plants of the Permo-carboniferous, coal measures, millstone grit and lower carboniferous, and of the upper, middle and lower Erian (Devonian), with special reference to the collections made by the author from these several formations; and discussed, also, the remains of plants found in the Siberian and older formations.

Remarks were made upon the subject by Dr. Newberry and Prof. White.

Prof. J. W. Whiteaves followed with a note on the occurrence of *Siphonotreta Scotica* in the Utica formation, near Ottawa, after which Mr. Samuel Lockwood read a paper on "A Mastodon Americanus, found in a Beaver Dam near Freehold, N. J." The author gave an account of his finding and exhuming the remains of a mastodon in the peat of a meadow, which he conjectured might have been the bed of an ancient beaver dam; in fact, beaver sticks were found overlying the skeleton, indicating that the dam was made after the death of the mastoton. The tusks of the animal crumbled on approach to the air; he supposed them to weigh about 400 pounds. It was thus shown that this mastodon was contemporary with the modern beaver, also with the autochthonic man. Mr. Lockwood though this particular animal was geologically quite modern. He described three special finds of mastodon remains within a few miles of each other, on the New Jersey coast—one from a drift-covered swamp close to the sea, and two other instances of relics obtained out to sea. These he adduced as peculiar evidence that the shore of a portion at least of the New Jersey coast had subsided, and from it he inferred that the subsidence had encroached some miles upon the land.

A NEW GEOLOGICAL SOCIETY.

Immediately following the adjournment of section "E" a meeting of geologists was held, to consider among themselves the organization of an American Geological Society, in no way to conflict with the American Association for the Advancement of Science, and to hear correspondence from eminent men throughout the country on the subject. The Committee, which had been formed about a year ago, submitted its report, which consisted of a series of

communications from leading scientific men, almost all strongly advocating the scheme, particularly that portion of it relating to the publication of a geological magazine. After some discussion, principally of a nature favorable to the undertaking, it was decided to adjourn to the Molson Hall, as the room then being used was required for other purposes. This was accordingly done and a private session was held.

BIOLOGY.

BIOLOGY OF AMERICAN MOLLUSKS.

The Vice-President, Prof. Wm. H. Dall, read his opening address, taking for his subject the "Biology of American Mollusks" and what knowledge has been acquired regarding them. The study of mollusks, he first remarked, was at first æsthetic rather than scientific, and to this day its popularity is chiefly fostered by the satisfaction of the sense of beauty derived from a contemplation of the exquisite shells produced by some members of this branch of the animal kingdom. The almost purely artificial classification of shell-bearing mollusks by Linnæus was so convenient that later on great difficulty was experienced in changing it, and confusion in the nomenclature yet puzzles the student. Thos. Say was the pioneer conchologist of America, and in 1816 published the first scientific article upon the shells of the country. For many years American students of conchology were occupied in the description and iconography of our native mollusks as an inevitable preliminary to the study of geographical distribution and other more philosophical branches of the subject. The molluscan fauna of the land and fresh water shells of North America is now very well known, although something yet remains to be done in the Southern States. With marine forms the case is different. The fauna of Canada and of the eastern coast of the United States had been worked very thoroughly by resident naturalists, and Carpenter, Cooper, Gabb, Hemphill and others had given a pretty good knowledge of the western coast, except the Alaskan coast. The mollusk fauna of the Arctic Coast is also well known. On the southern coast, especially about the Gulf of California, the knowledge is by no means thorough.

The speaker then referred to the rich finds of shells, recent and fossil, made in Colorado, Nicaragua, Laramie and elsewhere, and drew attention to the importance of the discoveries in the recent deep sea dredging. The anatomical features of the adult mollusks, except in a few groups, have been much neglected and are of no first importance. The soft parts of even our common oyster are differently described by different naturalists, and monographed by none. The instinctive and mental phenomena which may be exhibited by living mollusks have not yet been subjected to an investigation. A few persons merely had de-

scribed actions which, on mature consideration, might be held to exhibit mental processes of a certain kind.

The speaker had lately put on record certain observations which seem to indicate the possession by some species of the genus *Helix*, of the power to recognize a call or sound and distinguish it from other calls or sounds of a similar character, and since then he has received several less exact communications seeming to confirm this conclusion. It can hardly be doubted that in a group containing so many animals of a high degree of organization, such as the cuttles and squids, for instance, mental processes of a tolerably complex nature must be carried on in many cases. This subject has, as yet, received no attention. Another important branch of the subject is the modification of organic life by physical causes and the perpetuation of modifications by natural and sexual selection. Mollusks occupy the middle ground between the higher groups of life, where natural selection has its freest play, and those lower categories where its operations are veiled or inefficient. Investigation of the laws of variation among mollusks is therefore especially desirable.

The influences of natural selection are most evident, as they should be, in those mollusks which, by their terrestrial habitat, are brought into the closest contact with enemies of relatively high intelligence, such as birds and other vertebrata. The selected characteristics are chiefly of color. The grey and dull appearance of species inhabiting arid regions is well known. The speaker then described many of the shells noticeable for their varieties and complexities of color, and the causes of these differences, as far as known. Among marine forms, the struggle for existence, after the embryonic stages are past, is much less violent. This arises partly from the much more uniform conditions of life in the sea, partly from the general abundance of food contained in the sea water, and partly from the lesser intelligence of enemies which are chiefly fishes and predacious mollusks. Food has without question great importance, especially in determining certain tints of color. The speaker gave instances of the effect upon shells, in modifications upon them. Certain shells, said he, pick up and attach to their upper surfaces bits of dead coral, stones and fragments of shell, until they were entirely covered. Viewed from above, as they must be for the most part, by fishes and carnivorous mollusks, nothing but dead and refuse material is visible. It is evident that this system of clothing themselves by shells must be a great protection, both from enemies, which would pass them by, and from accidental concussions. This must be confirmed as a habit by natural selection. The character and disposition of the load has become so uniform in many cases, as almost to take rank as specific characters.

ANTHROPOLOGY.

SOME PHYSICAL CHARACTERISTICS OF NATIVE TRIBES OF CANADA.

The address of the Vice-President of the Anthropological Section, Dr. Daniel Wilson, F.R.S.E., was read in his absence in Germany, by Prof. Otis Mason, of Washington, the Secretary. The subject was "Some Physical Characteristics of Native Tribes of Canada." The following is a summary:

In inviting attention to some of the physical characteristics which distinguish certain native races of the Dominion, and especially to the significance of certain typical head-forms it is important to keep in view the prevalence throughout the American continent of various artificial modifications of skull-forms. This strange custom is probably at the present time carried on more systematically among the different tribes of Flathead Indians of British Columbia than in any other region. The practice of moulding the human head into abnormal forms has been found alike among the civilized races of Peru, the ancient lettered architects of Central America and Mexico, and among barbarous tribes both to the east and west of the Rocky Mountains. Among the Chinooks and other Flathead tribes of this continent, and also, I believe among the ancient builder-races of Yucatan and Peru, certain head-forms were recognized as an attribute of the ruling cast. One of the first examples of mediæval compressed crania, which attracted special attention in Europe was a skull found, in the year 1820, at Fuersbrunn, in Austria. The well known traveler, Dr. Tschudi, conceived that the skull was brought to Europe as a curiosity, and then thrown aside.

It thus appears that the practice of artificially compressing crania belongs both to the Old and New World. It is now recognized that the artificial head-forms characteristic of divers tribes of North and South America vary greatly. The predominant natural form of the more southern tribes of North America appears to have been globular. The type of head-form of the Indians of Hochelaga, first met by Jacques Cartier in 1535, we can judge from the crania recovered from their cemeteries. The palisaded Indian town of Hochelaga occupied, in the 16th century, the site where we are now assembled, and in the museum of McGill College may be seen examples of the crania. It is a noticeable fact in reference to the entire population of the western hemisphere that the ethnical diversities are slight when compared with those which pertain to the older continents. Great as is the superficial resemblance which seems to pervade the diverse tribes of the American continents some of the underlying differences are noted from the first. Columbus failed not to note the marked distinction between the fair complexion of the Guanches and the reddish olive of the ferocious Caribs.

While it is interesting to notice that the aborigines of Canada differ in certain physical characteristics from those especially of the Southern States it is true that the tribes of North and South America approximate in many characteristics. Humbolt remarked that "the nations of America, except those which border the polar circle, form a single race, characterized by the formation of the skull, the color of the skin, the extreme thinness of the beard, and the straight, glossy hair," and until very recent years this was accepted by every one. Among typical Canadian skulls, those of the Hurons of the region lying around Georgian Bay have a special value The race was exterminated, or driven out of the country by their Iroquois foes, in 1649, the crania recovered from their old cemeteries giving a fair illustration of the physical characteristics of the race.

Of all known races of the New World, the Eskimos alone presented, at first, a seemingly marked diversity from the other aborigines, traceable far more to Arctic conditions of life than to any ethnical peculiarities assigned to them. Malte Brun, Robertson, Humboldt, Morton, Meigs, Gliddon and Agassiz all concur in excepting the polar tribes, or Eskimos, from the assumed American race peculiar to this continent. Latham says of the Eskimos:—"Physically, he is a Mongol and Asiatic; philologically, he is American, at least in respect to the principles upon which his speech is constructed." One branch of them, the Labrador Eskimos borders on our own eastern settlements on the St. Lawrence. Then there are the East and West Greenlanders, and to the north of them are the Eskimos, of the west coast, north of Melville Bay, styled by Sir John Ross the "Arctic Highlanders." This widely scattered race is broken up into small tribes and isolated bands, dispersed for the most part over a coast line extending from Labrador to Behring Strait, upward of 5,000 miles. They are hunters and fishers. The deer, polar bear, wild goose, swan, and other birds are alike objects of the chase, but they primarily depend on seals and cretaceous animals. The Eskimos in one respect, occupy a peculiar position on this Continent. They are the only race common to the Old and New World, and if we accept the conclusion arrived at by the author of "Early Man in Britain," they constituted an Old World race to all appearance before the New World had come into existence.

Prof. Boyd Dawkins has reviewed the manners and habits of the Eskimos, a race of hunters, fishers, and fowlers, comparing their habits to those of the cave men of ancient Europe. The implements and weapons of both prove that their manner of life was the same, and what strikes him as the most astonishing bond of union between the cave-men and Eskimos, is the art of representing animals, and after noting those familiar to both, he says, "all these points of connection between the cave-men and the Eskimos can, in my opinion, be explained only on the hypothesis that they belong to the same race. The Eskimo's phisiognomy is of a poor Mongolian type. The nose is flat and cheek bones are very prominent, the tendency in the skull is narrow and long." The reasonable limits of an address to this section of anthropology are exceeded, and the various points of differences to the aborigines of the Dominion illustrative alike of the physical

characteristics of our native Canadian tribes, and of some special points of significance in relation to their arts are only glanced at. One deduction, however, may be worthy of future consideration. If it be a fact borne out by much independent evidence that from the extremest northern range of the Arctic Eskimo, southward to the Great Lakes, and beyond this, especially to the east of the Alleghany Mountains, amid considerable diversity of ethnical characteristics, the dolichocephalic type of head prevailed; whereas among more southern tribes, such as the Osages, Ottoes, Missouris, Dacotas, Cherokees, Seminoles, Creeks, and many others, including the Florida Indians, the short, rounded, or brachycephalic head appears to have been universal; this seems to point to a convergence of two distinct ethnical lines of migration from opposite centres. In this as I believe, the evidence thus derived from physical characteristics confirms what is indicated by wholly independent evidence of language, traditional customs, and native arts.

A SCHEME OF ANTHROPOLOGY.

Prof. Alex. Winchell, of the University of Michigan, Ann Arbor, Michigan, presided. There was a large attendance of members.

The first paper read at the morning session of this section was by Professor Otis T. Mason, of the Columbian University, Washington, U. S., on "A Scheme of Anthropology," of which the following is a summary:

Science progresses by observation, by the classification of phenomena, by the deduction of the laws of nature, and by inquiring into the origin and correlations of its objects. The amount of progress at any moment is indicated by the condition of the nomenclature. In every department of knowledge it is now deemed necessary to investigate origins or beginnings. The science of man must have its three stages of development—description, science, and law. These three stages are (1) the phenomenal, observational, descriptive; (2) the classifying, discriminating, analytical; (3) the synthetic, deductive, predictive stage. No branch of study is altogether worthy of the name of a science that has not passed through these three steps. The natural history of man, as a whole, will be divided into four parts; the first relating to the origin of man. Whatever view we take of man's origin in the first being, it is probable there existed in embryo the promise and potency of his future. The second part is the descriptive, including facts and objects necessary to correct inferences. The third part embraces all that has gone before, and finally all attempts to study the phenomena of human progress must end in understanding the law of that movement, so that it may be useful to the man of action in the future.

The gathering of crania, skeletons, implements of stone, bone, clay, shell, etc., the consideration of their position and the truthful report of what is observed constitutes the first lesson in priscan history. The pursuit, however, has little claim to be called a science as yet. There are hundreds of men and women,

archæomaniacs, ransacking the earth and wasting fortunes merely to satisfy a morbid desire for collecting. The work was, however, by a few done well. Time has dealt rudely with ancient man and his works. In the study of archæology, anthropology is involved. The anthropology of the present commences with the study of man as a member of the animal kingdom. It is only since the publication of Mr. Darwin's Origin of Species that diligent inquiries have been made into the method of man's origination. We must measure, weigh, scrutinize, dissect men ere we can arrive at any safe deductions regarding their animal nature. Then, we consider the science of mind. The observation of human thought, the careful collection of facts gathered from all races and ranks of men, are essential to a wide psychology. The consideration of language, the instrument of precision by which thought is gauged, the vehicle of thought between mind and mind. The process of thinking is double, consisting first in the creation of thought and second in the expression, expenditure, transfer, commerce of ideas and judgments. The expression and interchange of thought has been the subject of curiosity and research. The science of chronology, the indiscrimination of these characteristics which form the natural barriers between kindreds, tongues, peoples and nationalities.

Out of these studies of race, religion, etc., are to come forth the laws which are of the profoundest importance to the statesman and philanthropist. On this subject of race Lord Beaconsfield was ever dwelling. The sentence in Endymion, which declares that language and religion do not make race is fine writing, but not good ethnology. The next department for consideration is human industry. The happiness of man seems linked with the most perfect conquest of nature. Then we come to the study of the fundamental laws of the various occupations of men, how they grow, relate themselves to races, times and areas. After this, sociology. Companionship is the necessary condition of civilization, co-operation is the constant factor in this variable equation. To properly classify the phenomena of the family, the community, the state, it is necessary that the children should be impartially scrutinized and described. Finally, we are brought face to face with the spirit world, leading us to consider the conceptions of different peoples regarding the unseen causes of phenomena, the organization of society, the acts and ceremonies growing out of the ideas and social classes, the symbols and implements of worship. A science in which every human being is a constituent element will continue to take a deeper hold upon the intelligence of thoughtful people. It will be a sufficient reward for this humble undertaking if it adds anything whatever towards a just, and comprehensive view of anthropology as a whole, and of the varied studies which enter into its prosecution.

The Chairman suggested the application of the word theology to the science of religion as regarded by anthropologists, but Mr. Mason replied that the word was already too much occupied. After some remarks by Mr. C. Roosvelt, of New York, Mrs. Erminnie Smith, of Jersey City, N. J., defended the conduct of those so called archæomaniacs, who, she thought, had been somewhat

rudely handled. The Indians themselves had made good collections which would be of value.

THE CROSS AND THE CRUCIFIX.

The next paper was read by Prof. Mason on behalf of Col. Chas. Whittlesey, who could not be present.

The following is a summary: The object of the paper is to call attention to the difference between the cross and the Roman crucifix. Figures, having the general name of crosses, are quite diverse, and are widely dispersed. The symbol adopted by the early Christian churches had an upright part extending above the cross-piece. Among the Greeks the four arms were of nearly equal length. St. Anthony's cross resembles a capital T with a short horizontal part. The Maltese is so much distorted that it nearly loses its right to the name. It has frequently been asserted that the T form was derived from the ancient Phallic worship long before the Christian era, intended as a mitigated expression of an indelicate symbolism. Whatever value should be placed upon this interpretation, neither the form nor the association can be properly connected with the Roman crucifixes, which, like our rope and scaffold, was merely the machinery of executions. A figure precisely in the shape of the Roman cross might be found and not have any religious meaning whatever. On nearly all inscribed rocks of the United States there are characters or figures that closely resemble some of the forms of the cross. In most cases these inscriptions represent the work of the red man Little reliance can be placed on the interpretations, as they are so varied. Whatever they mean we cannot determine their value until there are translations covering not merely symbols and words but well determined sentences having relation to each other.

The Chairman said he understood the gist of the matter to be that the inference held by some that the symbol of Christianity proper existed in prehistoric times. There was no discussion.

Prof. G. H. Perkins, Burlington, Vt., gave a description of a collection of Sioux weapons and articles of dress in the possession of the University of Vermont, and invited members to inspect them.

The same gentleman afterward delivered an address on some "Recent Archæological Discoveries in Vermont." The following is a brief summary: In the locality of Monkton very many hammer stones made of quartz pebbles. Hundreds of these have been found. The great mass of specimens found are of a grey quartzite flaked into knives. Hatchets, hoes, spades, spear-points and other implements. Pestles of very diverse forms of fine work have been found. Celts, amulets, gouges and other fine specimens have been found. Chips and flakes in immense quantities. Cart loads of such flakes exist over perhaps an hundred acres of a farm. These must have been brought to the place as no such rocks exist in places near the locality.

Dr. McGuire, Ellicott City, Indiana, said he had endeavored to discover how the hammers were grooved, and had been successful.

A STONE GRAVE IN ILLINOIS.

The session resumed at 2:30 o'clock P. M. The first paper read was by Mr. Charles Rau, Washington, U. S., on "A Stone Grave in Illinois," the following being a brief summary: There seems to be a general impression that the so-called stone graves, so frequent in some States of the Mississippi Valley, belong to a remote period, at least to a time long anteceding the arrival of the whites in North America. In 1861, while engaged in the investigations into stone graves, he visited the farm of Dr. Shoemaker, near Columbus, Illinoes. There he saw an empty stone grave until lately the last resting place of a Kickapoo Indian. He could assert that the grave differed in no way from others seen by him in the neighborhood. In the early part of this century, the Kickapoos inhabited the country bordering on the central waters of the Illinois, but they roamed over the whole territory now forming that State and far beyond it. Mr. John D. Hunter, who lived many years among the Kickapoos, says burial is performed differently, not only by different tribes, but by the individuals of the same tribe. The body is sometimes placed on the surface of the ground, between flat stones set edge upwards, and then covered over, first by similar stones, and then with earth brought a short distance. It appears to me that the stone graves owe their origin to the race inhabiting within historical times, or even earlier, the districts where they are found. The method of burial, very simple in itself, was suggested by the facility of obtaining flag-stones suitable for the construction of these primitive coffins, which protected the dead most effectually from the attack of wild beasts. If, finally, due consideration is given to the circumstance that the articles found in the graves in question evince no higher skill than that attained by the more advanced of the historically known tribes of North American Indian, there hardly remains any reasonable ground for not ascribing to such tribes the humbler mortuary receptacles treated in this hasty sketch.

Mr. Hardy, of Indiana, described a mound which had been opened in his neighborhood.

Prof. Townshend, of Columbus, Ohio, mentioned the fact that an old grave had been opened in Ohio. The skeletons of a male and female were in it. Under the head of the male was a stone disc which identified the skeleton with another race of people. It is about fifteen inches in diameter, made of limestone, and thoroughly figured on one side with little squares.

Rev. Joshua Anderson, of Waterbury, Conn., said there was no reason to suppose that the American Indians did not extend back a good many hundred years.

The Chairman said it was not wise to come to hasty conclusions in this mat-

ter. In the question touching the identity of peoples who have lived in the different ages, more than the evidence of archæology was required. What the peoples were is shown by that which remains of them, the skeleton, jaws, and bones. The Peruvian skull is distinct from the skull of the North American Indian, and it seemed incredible that the two races represented should have been zoölogically the same.

CHIEF DEITIES IN AMERICAN RELIGION.

The first paper was read by Mr. A. S. Gatschet, the subject being the "Chief Deities in American Religion." He said, "The religions of all tribes discovered in North and South America belong to the category of spirit worship mixed with some lower or higher degree of anthropomorphism. Their deities are clearly nature gods, their worship is not a *cult* intended for merely improving the worshiper, but is propitiation, and propitiation is only another form of human egotism. The majority of these gods are austere, cruel and remorseless for their present objects and powers of nature, and like these they show no moral or sentimental aspects like monotheistic deities. At the time of their discovery, and a long time after it, many American tribes, although possessed of religion, seem to have had no priest, no ceremonial rites, no religious festivals, sacrifices or temples, and this induced some travelers who were unable to communicate in their own language and had not remained long enough to study their customs and ideas with becoming thoroughness to deny the existence of any sort of religion among them. Had they enquired for these burial customs they would at once have detected a belief in a future life, and such a belief is inseparable from religious ideas. A close examination of the initiation rights would have revealed the fact that most of these customs are of a religious character, the term religious to be understood, of course, in a more comprehensive sense than the one the Christian attaches to it.

The best term to depict the real essence or quality of American religion is not that of polytheism, but the one of polydaimonism, which means the worship of many spirits. In the motley crowd of ancient and new gods in American religions, a few only rise to general prominence, and among these few one is considered as the principal deity. The chief god is not always the most popular deity among men, but he is regarded as the most powerful among the gods, many of whom are found to be antagonistic to his rule. Chief deities represent a combination of several powers of nature united into one body. In the mythic stories of the people, this chief god is sometimes the most frequently spoken of; at other times he is placed in the background by one or two more brilliant, and therefore more popular creations of the aboriginal mind, and if his obnoxious or terrific qualities make him less attractive to man, his irresistible power will leave him the object of intense dread." The paper proceeded to investigate the chief duties of

South, Central and North America, of which we have any knowledge that is more than superficial. Among them may be mentioned the Botchika of the Muisca people, U. S. of Columbia, the Viracocha or "water-foam" and the Inti of the Peruvians, the Tezcatlipoca or the "shining mirror" of the Aztecs of Mexico, the Amotkan of the Selish, of Washington Territory and British Columbia, the Manibozko among the Ojibbeways. These gods were all found to be solar gods, while other deities of the same nations appearing in their mythology as rivals to the sun-gods or lunar-gods, the most conspicuous of them being Quetzalcoatl of the Aztecs. In looking over the large number of native American sun myths, investigators are induced to prove the opinion of the Jesuit Father Lafitau, who wrote in 1724:—"The sun is the divinity of the nations of America, without excepting any of those with whom we are acquainted. The more tribes we explore, the more we increase the number of men known to be sun worshipers, but through this inquiry another important result may be gathered with the majority of all tribes worshiping the sun, regarding the sun deity as their chief deity."

This the author of the paper claims to be the principal and highly important conclusion derived from his researches on the subject, and it is only the imperfect state in which tribal mythology is generally brought to our knowledge that hinders us from pushing on our enquiries in this direction. The only mode of getting at the real meaning of Indian myths, is to take them down from the myth tellers in their Indian language, and obtain a careful translation of their texts.

Discussion of the paper was adjourned until after the reading of the paper by Mrs. Erminnie Smith, of New Jersey.

BELIEFS AND SUPERSTITIONS OF THE IROQUOIS INDIANS.

Who can say that the first religious lesson (in embryo) received by primitive man may not have been received from the stern teacher, Death, and that a lifeless body did not first force upon him the conception of a spirit and spirits.

If so, the road must have been a long and painful one, from this first formless antecedent of a religious conviction to the complex system of the religions of civilized man.

But even a belief in spirits does not necessarily imply a worship of spirits or a conviction of their everlasting existence.

What stage in religious evolution had the Iroquois attained when first found upon this continent, and what is their religious state to-day.

Strange as it may appear, it is perhaps easier at this distance in time, with the accumulation of experiences, the better knowledge of their language and methods of thought, and the light gained through their folk-lore and traditions to judge of their past condition than it was for the pioneer who labored under the disadvantages and immense difficulties of deciphering a language so different from any written tongue, with all the invaluable scientific aids of comparative mythology and philology, contributed as they are to-day by every civilized nation upon the globe.

Up to within a half century to present a myth acceptably to the reading world, it must first be divested of its aboriginal setting, invested with a hero and heroine, have a plot and counterplot, or, if its kernel admitted, endowed with a great moral lesson laden with some proof of a universal deluge, or Hiawatha-like teach the doctrine of atonement, and repeat the story of the Ascension. The pagan Iroquois of to-day—and there are many—will tell you that his ancestors worshiped, as he continues to do, the "Great Spirit," and that they like himself held feasts and dances in his honor. But a careful study of their mythology proves clearly that in the place of one prevailing "Great Spirit," the Indian's earliest conception of the white man's God—the Iroquois gods were numerous, for all that which with them inspired reverence, awe, terror or gratitude became deities or human beings endowed with supernatural attributes. "Hih-Nun," the beneficent Thunder God of the Iroquois compares most favorably with the same God as worshiped by other races.

Among the supernatural beings corresponding to good and evil genii, we find the Great Heads with ever watchful argus eyes, and long hair which served as wings to bear them on missions of mercy or of destruction.

The only word for heaven in the different dialects is evidently a literal translation of the Christian idea and signifies "in the sky." The medicine man with his supernatural endowments, worked for the good of the Indian, and it is claimed foretold the coming of white man, but the idea of evil spirits inhabiting living forms only came with the white man and his teachings of literal heaven, hell and devils!

Among the highly civilized Chaldeans, Egyptians and Greeks the success of magic depended upon the ignorance of the masses. The Iroquois witch stories would alone fill a volume. Gifted as are their narratives with such scopeless imaginative powers, and free from the trammels of adapting these stories to any standard of possibility, their absurdity might to the pale face seem incomprehensible were not the atrocities of Salem still fresh in his memory. And the same holds true regarding their stories, explaining to their entire satisfaction the various phenomena of nature many of which are the "burning questions" of the scientific world to-day. But how recently were we all content with solutions now considered untenable. Let us then accept these oral traditions reverently as the stirrings of the infant human mind, in its search after the "unknowable" containing perhaps the germ of a belief, certainly revealing that inherent "something" in man which pre-supposes the existence of the hidden forces, powers, or beings in nature. At first this may be but a mere blind feeling, but as man develops it becomes an idea, then a recognized possibility, finally an article of religious faith.

INDIAN MIGRATIONS AS EVIDENCED BY LANGUAGE.

BY HON. HORATIO HALE.

In this paper the author undertook to trace by the evidence of language, verified to some extent by that of tradition, the course of migration which has been followed by the tribes belonging to some of the leading linguistic stocks of North America. The Cherokees were shown to belong to the Huron-Iroquois stock, but to have received accessions to their vocabulary from some other source. The Huron language was shown to be the oldest in form among the languages of this stock. The migration of the Huron-Cherokee tribes was traced in a course leading from the northeast to the southwest, that is, from the lower St. Lawrence to northern Alabama.

The Dakota stock was next considered. The Tuteloes of Virginia and North Carolina were shown to belong to this stock and to speak a language which is older in its forms than the language of the western Dakota tribes. The Algonkin tribes and languages were next examined, and the evidence was exhibited which shows that their migration probably flowed from Hudson's Bay and Labrador towards the south and west. The tribes of the Chahta-Muskoki family were noticed, and the fact was pointed out that their language, like that of the Cherokees, has apparently received accession from some alien speech. Some reasons were given for supposing that this speech was that of the mound-builders of the Ohio Valley. Traditionary and linguistic evidence was adduced to show that the mound-builders were conquered and partly exterminated by the Iroquois and Algonkins, and that the survivors, mingling with the Cherokees and Choctaws, caused great changes in the languages of these nations.

The fact that the course of migration seems to have been from the Atlantic coast towards the interior was regarded as evidence that the ancestors of our Indian tribes were emigrants from Europe. In support of this opinion, reference was made to the close resemblance in structure between the Barnque and Indian languages. It was further suggested that if the Aryan intruders, entering Europe from the east, encountered and absorbed a population resembling the American aborigines, this fact would account for the great changes which the Aryan speech underwent in central and western Europe. It would also account for a very remarkable change which took place in the character of the intruding race. The Aryans, who in the east have always been a submissive and contemplative race, devoid of the idea of popular government, became in Europe a high-spirited, practical nations and liberty-loving people. The conclusion is that the of modern Europe are a people of mixed race, forming a transition, in physical and mental traits, between the eastern Aryans and the aboriginal Americans.

SOME HITHERTO UNNOTICED AFFINITIES BETWEEN ANCIENT CUSTOMS IN AMERICA AND OTHER CONTINENTS.

DR. J. W. PHENÉ, F.S.A, F.R.G.S., F.G.S., OF LONDON.

The author of this paper explained that as one of the great problems to be worked out, or which at least it is desired should be worked out, by all who have given any attention to the subject, is that of the races and civilizations which once flourished at the southern end of the northern continent of America, and which had evident connections with the more northern parts of what are now the United States, through those great ducts, the Mississippi and other vast river valleys, tending to the latter direction, he had devoted many years to the investigation of the subject. He had read papers upon certain particulars of this subject in the capitals of those countries in which he had found corresponding remains, so far as those particulars applied respectively to such countries. Great difficulty, he said, existed through absence of literary records, possibly lost in the destruction of such evidence by the conquerors of Mexico, the only city and country in which civilization with rude but graphic literature and illustration existed on the face of this vast continent. And the difficulty was increased from the fact that, rude as it was, civilization had then reached a point at which literature became essential, and though now, to a great extent, lost had then actually taken root. Arrested by such barriers, any information which bears on the subject was important, the more so if, as in the present case, such information had been carefully collected by the devotion of years of personal investigation and travel to its acquirement.

The customs which are shown to have existed in the great river valleys of America, though read with difficulty by the light of the strange monuments still existing there, seemed to the author to have had parallel existences on the other continents. In evidence of this he gave illustrations, by drawings and diagrams, of many earthworks and stone constructions which had been examined by him in company with a large number of scientific men, and which agreed in the method of executing the earthworks, of arranging the plans and designs, and in the evidently similar purposes for which they were designed, and to which they had been devoted. It was his intention to avoid all theories whether his own or others, upon the origin of the monuments, the nationalities of their constructors, or their special purposes, though the latter in most cases were apparent. Nor should he in this paper give any account of the American earthworks, except where comparisons with others became necessary, as the whole subject of the American works had been so ably brought before the public by such eminent men as the late Mr. Squire and Messrs. Lapham and Davis in the *Smithsonian Contributions to Knowledge* and other works published under authority at Washington.

The points on which he rested his argument for the affinity of the American mounds and earthworks, and, necessarily, the customs with which they were connected, with those of Great Britain and a large number of similar works in France, Spain, Greece, Asia Minor, Persia and China, were, in the first instance, the existence of relationship to each other, always in the vicinity of rivers, of mounds representing animal forms, and—with some special exceptions—the close proximity of vast works of camps for defense, huge enclosures or oppida for civil occupation, and other evidently sacred enclosures for solemn rites, worship and sepulture. In America these evidences went no further, but in the vicinity of the mounds he had traced in Western and Eastern Europe, and in Asia Minor, and still further East, not only were all these features attendant but the localities also abounded with mythological and traditionary legends, and the retention of strange and weird ceremonies to the present day.

He selected as illustrations of the American mounds, those in the forms of serpents, the alligator (or mythical dragon), and the human form. The serpent was shown, by the late Mr. Squire, to have been executed in two ways, viz:—by the solid continuous serpentine form, and by a series of symmetrical mounds uniformly placed in curves. The reader gave examples of each of these, on diagrams, and explained that they existed in large numbers in Great Britain, similar in proportions and construction to those of the American mounds, which were kindred in form, and accompanying these were, he stated, in every case, extensive areas occupied by similar camps and enclosures for civil occupation, or oppida, and also separate enclosures for worship and sepulture. The characteristic physical, natural and art features were also curiously persistent in each case, a triple imagery having been in very many instances studiously represented, both by places of selection, as the vicinity of triple peaked mountains, and in construction, by triangular chambers and triangular enclosures in or about the head of the animal forms, as well in the American as in other similar mounds. Since his arrival at Montreal he had heard of indications of this having been an Indian burying ground. They appeared often to have selected places of previous occupation, as in the mounds; and the triple hill and triangular piece of land at its base were significant. The works in Great Britain, Spain, France, etc., were found to contain chambers filled with cremative matter, and had studied arrangements for preserving the outlines of the animal forms, as shown in the diagrams, and were generally surrounded with vast lithic arrangements, and each, as a rule, was in the centre of an extensive necropolis of the primitive inhabitants The legends and traditions clustering about these places were always of the same class in the other continents, and almost always had reference to man as the possessor and the serpent or dragon as the persecutor or destroyer, and this whether the tradition was one of uncultured and primitive existence, or of the highest classical art ages and localities; and though such traditions did not exist in America, yet not only did their huge mounds simulate these forms, but there had been dug up from their mounds rude sculptured figures of the human form and also of entwined or coiled serpents, showing that in their construction the

same ideas, if not similar legends and traditions, had existed, as those which originated the gigantomaxia of Pergamos.

Amongst their numerous and striking examples of these forms in Great Britain, corresponding with the animal and human forms in America, were some very remarkable and yet but little-known representations of the human form belonging to a rude and unlettered age, perhaps corresponding to that of the semi-barbarous age of Mexico, which are found on the coasts of Devonshire and South Wales sculptured in stone, a very remarkable example of which also existed near West Hoathly, in Sussex, which was traditionally stated to have been worshiped as a potent deity (the Goddess Andras) by the early Keltic inhabitants. In the vicinity of these rude figures in the western and eastern extremities of the South of England, were two enormous *intaglio* representations of the human form, corresponding to the *intaglio* forms at Milwaukee, in Wisconsin, only one of which had been mentioned, and that in a very cursory manner, by writers on the comparison of these works with those of America, while their surroundings had been completely overlooked. The one not referred to was by far the more important, both in size and similarity, being in the exact attitude of the mounds in the human form of the American mound-builders. About midway between these two figures was an equally enormous and well-known representation by *intaglio* of a horse.

These figures were all cut in the chalk hills, and might be said to be protecting deities of the three localities in England most abounding in remarkable and vast areas of camps, oppida or settlements, and places of worship. The whole district from Dorsetshire to Land's End being commanded by the gigantic form in Dorsetshire; that of the miles of stone avenues on both sides of the Medway in Kent, terminated by Kit's Coity House at one end, several *aleés couverts* at the other, with the huge stone figure at West Hoathley and the wood of Anderida to the south, were commanded by the similar gigantic *intaglio* figure in Sussex; and the central and more important districts of Stonehenge, with the primitive and stupendous temple of Avebury, its sinuous avenues of stone, and extensive earth embankments, the great tumulus of Silbury Hill, the avenues of stones near Amesbury, in the style of those at Carnac in Brittany, the large number of camps, the trilithon called the "Devil's Den," and the great dolmen known as "Weyland Smith's Cave," appear under the protection of the "White Horse."

Metallurgy, a great feature with the mound-builders of the Mississippi, was also the peculiar occupation of one, if not of two, of these three districts of southern England and of many of the other localities in which similar works were found in Europe and Asia. And such metallurgy was for all utilitarian purposes confined in every such country in which these works exist to the two metals—tin and copper—and analysis showed the proportions in the amalgamation of those metals to have approximated in America, Europe and Asia. The parallelism went further and was continuous in its track eastward. Brittany, Spain and France on each side of the Pyrenees, and so on to Asia Minor had the same combined features. In the valley of the Meander in Lydia, the vast figure of "Ni-

obe," mentioned by Homer, still existed, sculptured on the side of Mount Tmolus, and, as well as that of "Sesostris" in an adjacent valley, also so sculptured, overlooked the district in which are the multitudinous tumuli near the Gygean Lake; and the fortifications and camps of the acropolis of Sardis corresponded with those already referred to in position and design; and the same features were found at Ephesus, Smyrna and Pergamos in a striking degree, and extended, as shown by careful drawings and diagrams, onwards eastward as far as China. Considering the skill and thought required to plan such enormous figures with any regard to proportion, and seeing that all the figures had similar accompaniments, the author concluded by observing that they seemed to him to have been the result of a practice and culture transmitted with concurrent customs by way of the Pacific from one continent to another.

MICROSCOPY.

HISTOLOGY AND MICROSCOPY.

Prof. Tuttle presided and read his opening address. He referred to a little sub-section of the annual meeting of the American Science Association at its annual meeting in 1869. This was the first organization of such a section. Little was then known of microscopy compared with what is known now. Microscopy was then almost in its childhood. In those days any one who wanted to buy a microscope had to hunt for it. The speaker traced the growth of the section and of microscopy in importance. The work of the section had contributed to vastly increase the knowledge of microscopy in the United States and led to the establishment of an American society of microscopists which promises to do much good. He stated the arguments in favor of the establishment of a separate section of microscopy.

The section then proceeded to organize. Dr. R. H. Ward was elected Fellow of the General Standing Committee, Dr. A. B. Hervey, Dr. L. Elsberg and Prof. R. Hitchcock, members of the Sectional Committee, Prof. J. D. Hyatt, the Fellow of the Nominating Committee and G. D. Mitchell, Prof. T. J. Burrell, and C. C. Merriman, members of the Sub-Sectional Committee, to nominate the Vice-President and Secretary for next meeting.

The Chairman then introduced Dr. Wm. B. Carpenter, of London, and announced that Dr. Carpenter would contribute a paper or two for the section.

THE HOUSE-FLY AS A CARRIER OF POISON GERMS.

THOMAS TAYLOR, MICROSCOPIST DEPARTMENT OF AGRICULTURE.

About eighteen months ago, while dissecting the head of a common house-fly, I observed a very minute, snake-like animal, a species of auguilula, moving out of the posterior end of its proboscis, which was ruptured. It measured about eighty-one hundredths of an inch in length by about two one-thousandths of an inch in diameter. Subsequently I determined to ascertain the interior dimensions of the suction tube, or proboscis, of the house-fly, for the purpose of comparing it with the diameter of this parasite. Placing a fly which I had asphyxiated with naphthaline on a glass slide, and securing it on its back by means of thick gum, I was able to measure the parts and observe all the movements of its proboscis, and found its suction tube to be of sufficient diameter to admit of taking up the spores of cryptogams, trichinæ, the eggs of auguilula, or even the auguilulæ themselves.

Noticing a violent commotion in the abdomen of the fly thus operated on, I became convinced that one or more of the auguilulæ were present in the abdomen, and were the cause of the unusual movements observed. On removing the head of the fly, a lively auguilula was seen moving out from one of the ruptured ends of the œsophagus. The animal was quickly secured, and placed under a glass cover in a drop of water, where it exhibited very eel like or snake-like motions. Shortly a second appeared, when all commotion in the abdomen ceased.

Of the genus auguilula there are upwards of one hundred known species. They abound in the mosses, in damp earth, and on the green algæ found growing on the walls of moss-covered flower-pots. Auguilulæ are very numerous about the roots of vines, plants, and grasses, and are generally found on decaying moist grain—as wheat—on the bark of trees, and sometimes within fruit while growing. One species of them is found in very large numbers in vinegar. The species I have found in the house-fly exhibits different internal structure, in some respects, from any others that I have yet examined. Whether it is identical with that observed in India by Dr. Carter, and more recently by Dr. Leidy, of Philadelphia, to which the name of filaria muscæ, and also by Cabold, the name auguilula muscæ has been applied, I cannot determine in the absence of detailed descriptions and drawings representing members of that species.

The facts above stated suggested to my mind the importance of instituting a series of experiments to ascertain whether house-flies might not be carriers and distributors of germinal virus. I have found in the proboscis of a single house-fly thirteen of the animals already mentioned in a perfectly developed condition, and on the thorax of another I have found sixteen living parasites of the genus acarus. It therefore seems quite possible that other microscopic organisms might be taken up by the house-fly, and again deposited where they might prove dangerous to man. This might easily happen in the case of trichinæ, as trichnosed

cut meat is frequently exposed for sale in our markets, where flies abound. Considering the habits and habitats of the house-fly, it will appear evident that should it prove to be a carrier of poisonous bodies, its powers to distribute them in human habitations is greater than that of any other known insect. Under our system of public travel, the common house-fly may be transported from one end of the continent to the other. It may feast to-day in the markets of Washington, and to-morrow in those of New York, and in a like manner it may be transported from a hospital for contagious or infectious diseases to homes in the vicinity, or even in remote localities. It may also be taken from one hospital to another, or from one ward to another within the same hospital, and may plant the germs of disease in exposed wounds, or deposit them in food, or liberate them in the atmosphere breathed by patients affected by diseases of a different class.

Many of the germs of putrefaction—spherical bacteria, for example—are individually not larger than one forty-thousandth part of an inch in diameter, and over 30,000,000 of these in a state of aggregation could pass through the eye of the finest needle; and owing to their minuteness, millions of such germs could easily be carried to a distant city by a single fly. We should take into consideration also the rapidity with which such forms of bacteria multiply. A bacterium which will reproduce by fission (the one dividing into two) in one hour may in twenty-four hours have a posterity of 33,000,000, for a geometrical progression of twenty-four terms, with one for its first term and two for its common ratio, has 33,554,432 for its twenty-fourth term.

To test practically the question whether flies may become the carriers of contagious germs, I instituted a series of experiments. In a glass receiver having a capacity of about five gallons of air, I placed several hundred house flies which had been caught in an ordinary fly-trap. Within the receiver was placed a quantity of the spores of the red rust of grasses, (tricholoma rubra-vera). The flies at first did not seem to esteem the spores as suitable food, but on the morning of the third day I found that the rust was replaced by larvæ and remains of eggs of the common house-fly.

The eggs were deposited and hatched between Saturday noon and the following Monday morning, 9 o'clock, or in about forty-eight hours On the following day I placed in the receiver about a quarter of an ounce of the same description of spores combined with sugar. The flies partook of this confection, consuming the sugar and most of the spores. In about twenty-four hours after the flies had partaken of this mixture I killed and dissected a number of them, and found the small intestines intensely colored, of a deep reddish orange shade, representing the digested spores of tricholoma. I observed in the contents a few well-defined orange spores, but none of them appeared to have germinated.

Fastened between the hairs on the limbs of each of the flies examined I found a number of the spores, and the efforts of the fly to get rid of them only resulted in attaching them more firmly to it. They might, however, be brushed off by objects with which they were brought in contact, while their germinating powers would long outlast the life of the insect itself. It was evident from this

experiment that flies were capable of conveying such spores to plants and other bodies. On the other hand, the fact that by far the greater part of the spores were consumed, in the one case by the larvæ of the fly and in the other (*i. e.*, when mixed with sugar,) by the fly itself, shows that this insect may destroy microscopic germs as well as disseminate them, and indicates that in some cases its agency in keeping down their number may more than counterbalance its action in contributing to their dissemination.

In another experiment a quantity of yeast was mixed in water and placed under a glass receiver into which the fly-trap had previously been emptied. The flies partook sparingly of the yeast fungus, and after the lapse of forty-eight hours several of them were found dead, but the rest, amounting to several hundreds, appeared wholly unaffected. On examining the abdomens of the dead flies I found them congested and cheesy; and when the intestinal contents were mixed with pure water, a drop placed under the microscope was found to be strongly charged with both spherical and rod-bacteria and with several kinds of spores, but very few spores of the yeast-plant were seen. Several flies, which were immersed for a moment in yeast water, died in about twelve hours after immersion, while those not so treated sustained no apparent injury, though confined several days in the same chamber. But I do not consider the experiment conclusive as to the injurious effects of the external application of yeast on flies. I propose to test this question more fully at a future time.

The odors of the yeast on the fourth and fifth days, although very obnoxious to the human olfactories, did not seem to affect the health of the flies. In my next experiment, several hundred flies were confined in a glass receiver as before, in which was placed about an ounce of fresh beef thinly cut. A small quantity of pure water was also supplied in a watch-glass. The flies for a while enjoyed the beef and the water. Their consumption of the beef was proved by well defined cavities which they made in it, and the fact that solid tissue was thus consumed by the flies affords another evidence of the facility with which the eggs of auguilulæ, including those of trichinæ, if present in meat partaken of by them, might be passed through their proboscis along with food.

On the fifth day of their confinement I observed that a number of the flies died within the chamber. By this time the meat was in a state of advanced decomposition, and its odors were very offensive.

In comparing the results of this experiment with those of the one last described, it appears that the odors emitted from decomposing beef were much more hurtful to the flies than those proceeding from decomposing yeast. I removed with a knife all the soft surface portions of the beef which were exposed to the flies my object being in part to ascertain whether any auguilulæ had been deposited on the beef by the flies. I also examined the water for auguilulæ, but failed to find any in either case. On two occasions I have observed an auguilula bore through the membrane of the anterior portion of the proboscis of the fly and emerge from the hole thus made. In using a power of about 500 diameters under favorable conditions it will be seen that these animals are armed with a bor-

ing apparatus, consisting of from three to four projections, situated on the anterior portion or mouth parts of the animal. The precise form of the mouth parts is not easily defined, and its ascertainment is rendered more difficult by the great tendency of these animals to shrink and become distorted in most of the mounting fluids, or to become too transparent in others. Under a power of seventy-five diameters the general structure is very well defined, but a one-tenth immersion is required to give proper defination of the nervous system. In practice I find that a strong solution of pure white glucose serves the purpose of a mounting fluid better than any of the mounting fluids in general use.

ECONOMIC SCIENCE.

ECONOMIC SCIENCE AND STATISTICS.

The economic science and statistical section met at half past two to hear the address of its Vice-President, Mr. E. B. Elliott, of the Treasury Department, at Washington, U. S. There was a good attendance of members. Mr. Elliott said:—In 1857, at the former meeting held in Montreal, I had the honor of reading a paper on the mortality statistics of the State of Massachusetts. A resolution was presented at that meeting inviting Congress to commence a registry of births, deaths and marriages. A committee was appointed to report on the various registration systems and what was desirable in order to come to some practical end. At the last session of Congress a resolution was introduced into the Senate requiring the bringing about of a co-operation of the General Government with the several State Governments to secure some uniformity. The Cherokee Indians had made a very full census, and the conclusion arrived at was that we might have full tables from them before we had them from some of our own States.

This section enters on its separate action this year. Economic Science and statistics, economics relating to man and his welfare, man, what he is, what he controls, and the surroundings over which he has little or no control. The subjects of this section are scientific, they had to deal with facts. They might, however, attain to questions to which statistical methods are adapted. Facts susceptible of numerical statement and of arrangement into groups, numerical laws based upon and eliciting facts which will admit of, and offering facilities for their trustworthy production in the future, as, for example, the construction of life and annuity tables, and the financial condition of communities. It may be desirable, at some not very distant date. to organize a sub-section to consider the application of the mathematical doctrine of probabilities to statistics. One of the subjects pertaining to this section is that of standard time. Man, until a few years ago, might be considered as stationary, of late moving. There are more than seventy different standards of railway time in this country, and these might be re-

duced to one, or at any rate, three. The study of the laws of trade was another subject worth attention. The construction of life and annuity tables, the question of finances, and the divisions of time were all belonging to this section. When the Julian Calendar was changed to the Gregorian a very important change was made, but there might still something be done, as for example equalizing the months as near as possible. These were a few topics which might be brought before the section.

MISCELLANEOUS ITEMS.

OPENING OF THE REDPATH MUSEUM.

On Wednesday evening the formal opening of the Peter Redpath Museum took place, and the occasion was embraced by Principal and Mrs. Dawson to hold a reception of the members of the Science Association. Shortly after eight o'clock guests began to arrive, and for an hour and a half carriages were rolling up the University drive to the Museum. Guests were received by Dr. and Mrs. Dawson in the large hall. The number present would be about six hundred, of whom half were ladies. Among the guests were nearly all the principal *savans* attending the Meeting and also the *elite* of Canadian society. From the gallery spectators had a fine view of the brilliant scene below them.

By nine o'clock the various rooms presented quite an animated appearance, the various objects in the Museum being well inspected. Here and there in a quiet corner might be seen some old gentleman who had found a treasure enjoying his intellectual treat. Dr. W. B. Carpenter, of London, exhibited some photographs taken from figures of the *Eozoon Canadensis* which were highly appreciated. The general appearance and arrangement of the building gave great satisfaction, one gentleman being overheard to say that he had seen almost all the principal museums in the States, but no one could boast of a home as good as this. About half past nine the ceremony of presenting the deed of gift took place. Upon a raised platform at one end of the Hall, Principal Dawson took his stand, and with him were Chancellor Day, Mr. Peter Redpath, Mr. W. C. Baynes, Registrar, and Mr. R. A. Ramsay, Treasurer of the University, also Dr. Carpenter, of London, and Professor Hall, of Albany.

The Chairman briefly introduced to the gathering the benefactor of the museum.

Mr. Redpath said: Mr. Chancellor,—I would fain have had ceremony dispensed with on this occasion, but as some ceremony seems to be demanded I am here by invitation for the purpose of transferring to you as the representative of McGill University, in the presence of this distinguished company, all my right, title and interest in the building in which we are assembled. The conveyance

without other condition than that the building shall be maintained for the purpose for which it has been erected, will be found in the document which I now place in your hands. The undertaking was not begun without deliberation, and now that we have come to the end under such happy auspices, I see no reason to regret what has been done. I trust that the benefits which it was intended to confer will be realized.

Chancellor Day then said: Mr. Redpath,—It is my good fortune, as Chancellor of McGill University, to be its mouthpiece on this auspicious occasion. In the name and on behalf of that institution, I accept the gift of the Peter Redpath Museum, now formally conveyed to it. It is a difficult task to express in fitting words our sense of the obligation under which you have laid, not only this University, but also the friends of education, in the interesting and important department of science which your liberality is intended to promote. The architectural beauty of this edifice in which we are assembled—its classic design—the elegance and completeness of its finish, make it of itself an education of no small value; while, joined to these excellences, its ample proportions and perfect adaptation to its destined uses indicate the munificence and wisdom of its founder. We trust it will remain for future generations what it now is, a majestic monument, bearing the honored name of him in whom the power of riches has been added to the better gift of a disposition to distribute them with a bountiful hand for the welfare of mankind. Reference was then made to the collection which Dr. Dawson had presented, and the Chancellor proceeded.

The prodigious growth of material prosperity in our age, the marvelous creations of art and industry which cover the face of the civilized world, and the consequent increase in dangerous luxury have in them a voice of warning. History tells us what they mean if left to themselves, without the restraining and elevating agencies which build upon them a true and permanent civilization. We accept this hall of science as a noble contribution to those higher agencies, and now before this assembly, made august by the presence of our distinguished guests, true kings of the realm of thought; their presence, and in the presence of the benefactors of this University, enlightened men, and not less sympathetic and generous women. We dedicate the Peter Redpath Museum to the study of the varied and wonderful manifestations of God's creation, and emphatically we dedicate it to the use of the earnest student, who in reverent questioning of the works of living nature, and in their records upon the stony tablets of a dead and buried world, seeks that vital truth which, above all other things, it imports the immortal spirit of man to know.

Dr. Carpenter was then called upon to say a few words. He said when he received the invitation to take part in the meeting he felt that he could not refuse, because he wished to give expression to the very strong and earnest interest he felt in this beautiful city. Nothing had been of greater interest to him since he had been in the city than to be accosted on all sides as the brocher of Philip Carpenter. Every citizen of Montreal seemed to have known and honored and loved him. All honor was due to the donor of that building. Reference was

made to the remarkable collection of fossils, termed *eozoon canadense*, and to the numerous opportunities afforded to students to acquire knowledge now as compared with the opportunities which existed when he was a young man. He rejoiced at the thought that natural science was now fairly on its legs, and he was confident that it would keep pace with all the great departments of physical science, and concluded with a eulogy upon science as a means of disciplining the mind.

Professor Hall entered into a brief description of the collections. He said they had been placed in order to allow the study of them from the earliest to the most recent geological period. All that was required now was a staff of teachers which would render available all these valuable objects, instead of permitting them to lie idly upon their shelves. The building was in itself a beautiful object of art, adapted for the work in its systematic arrangement.

Dr. Dawson briefly acknowledged on behalf of the Association the great benefits that had resulted to science from this benefaction, and the meeting separated, many to see the exhibition of photographs of American caverns, with explanatory lecture by the Rev. H. C. Hovey, New Haven, Conn., others to still further examine the valuable collections in the Museum.

During the evening choice selections of music were rendered by the band of the 6th Fusiliers.

THE TRIP TO QUEBEC.

Quebec and its neighborhood are so rich in historic associations, so full of interest to the student of science, that the large number of those who took advantage of the opportunity to visit the ancient Capital, is not surprising. The excursionists left by the steamer Canada, which had been placed at their disposal by the Richelieu & Ontario Navigation Company, shortly after half-past seven o'clock on Friday evening. In the morning, people began to throng around the sides of the boat to catch the first glimpse of the "Gibraltar of America." Shortly before eight o'clock the Canada hove to at the Richelieu Company's wharf and the coming of the Committee of Reception was awaited.

Punctually at a quarter to nine His Worship the Mayor the Hon. F. Langelier, together with several members of the City Council and local committee of reception, came on board and were received and introduced by Dr. T. Sterry Hunt, Professor Mendenhall, Dr. George Cooke, Professor Eastman, Dr. Proudfoot, Mr. J. S. Shearer, Major Huguet-Latour, Professor Harrison and Professor Trowbridge. After a short time spent in introductions and conversation the whole party left the boat and wended their way to Dufferin Terrace, where the formal welcome was to take place

From the Terrace the party made their way to the Citadel, the Mayor acting as *cicerone* to the leading group of *savants*. The whole of the fortress was, through the kindness of Lieutenant-Colonel Irwin, thrown open to visitors who showed

the greatest interest in everything they saw, wandered from the sally-port to the King's Bastion whence they gazed in admiration on the magnificent view obtainable from that lofty point, and having feasted their eyes on a panorama of country unsurpassed in this country, visited in turn the different points of interest within its walls.

Laval University was the next point to which the visitors were conducted. Here they were most courteously received by the Rector, the Rev. Mr. Hamel. Guided by that gentleman, Dr. T. Sterry Hunt, and still by Mayor Langelier, who is a distinguished graduate of the University, and holds the professorship of Civil and Public Law, the party inspected the class-rooms and museum and picture gallery. Leaving the quiet of this abode of learning, to which the busy hum of the wharves, the next destination of the visitors, presented a strong contrast, the steamer Canada was again reached.

At one o'clock the steamer started for an excursion around the harbor, visiting St. Romauld, the graving dock at St. Joseph de Levis, the Falls of Montmorenci and the new harbor improvements at the mouth of the St. Charles. Lunch was next in order. The bill of fare was somewhat a curiosity in its way, and copies were eagerly sought for as souvenirs. We subjoin it for the benefit of those who failed to obtain it on board. The compiler, we are informed, was a gentleman named Bazerque:

MENU.

PIECES MONTEES.

Les Aiguilles de Cleopatre a la Mariette-Bay. LeCosmos de Leibnitz.

HORS-D'OUVRE.

Sardines d'Archimede, et Thales. Olives en postulatum d'Euclide.
Croque en bouche Apollonius. Beurre de Copernic et Pascal.
Theoremes algebriques de Diophanie. Viete et Dawson.
Geometrie descriptive de Monge. Calculs Trignometriques d'Hipparque.
Sinus d'Euler et Descartes. Pendule d'Ebn Ionis.

POTAGE GEOLOGIQUE.

Eli de Beaumont, Lavoisier, Bernard Palissy, Huygens.
Werner, Logan, Hunt.
Lyell et Brongniard. Scipion de Breslack.

ENTREES.

Filets d'Aristote et de Cuvier.
L'Homme de Platon, emince a la mode d'Aristote.
Jambons du Chimborazo a la Humboldt.
Vibrations de Canard a la Galvani, Bunsen et Volta.
Les Cotelettes d'Agneau a la Tycho-Brahe.
Galantine de Volaille a la Franklin.
Langues a la Cuvier Newton. Gibier a Oersted, Jamin, Dana, Mayer,
Aspics de Cleopatre a la Gullieb, Haller, Halley.
Milne Edwards, de Magendie.

ROTIS.

Le Canards a la Darwin, Littre, Lockyer, Langley et Maury.
Les Roastbeef a l'Hoppocrate et Bichat.
La Tete de Veau braisee a la Lavater.
Logarithmes de Monton a la John Napier.
Bombe Glacee au Magnetisme terrestre de General Sabine.
Evolutions de Faisan a la Galilee.

DESSERT.

Eclairs Edison. Peches de Monge et Agassiz.
Amades Laplace et Lacondamine. Raisins Wurtz et Arago.
Abricots Champollion. Prunes Gallien.
Noix Boussingault, Bertrand, Kœnig.
Claret Punch Jules Verne et Flammarion.

On the return trip the visitors were asked to assemble in the main cabin, and the Mayor, ascending the upper gallery, proposed the first of the toasts, that of "Her Majesty the Queen." The sentiment met with a hearty and generous response, and amid cheers the band played the National Anhem. "The President of the United States" followed, accompanied by the inspiring strains of "Yankee Doodle" and an outburst of cheering. Mr. Wasson, the American Consul, responded in an exceeding happy manner. "The Governor-General and Her Royal Highness the Princess Louise" having been honored loyally, "Our Guests" was given, the band playing "The Star Spangled Banner."

Dr. Sterry Hunt being loudly called for, replied. Dr. Hunt alluded to his long connection with the Association, spoke of its international character and the progress of the work it had in hand; referred to its previous visit to Quebec, and in closing, described some of the interesting features of Quebec, both from a geological and historical standpoint.

Dr. Barker also replied appropriately.

The Hon. D. A. Ross then introduced Mr. J. M. Lemoine, F.R.C.S., who gave a brief but very interesting sketch of Quebec history. Mr. Lemoine had also prepared some memorabilia for the information of the visitors, which were printed and distributed amongst those on board.

The business of speech-making being concluded, the Canada, a few moments afterward reached the wharf again, and the passengers, bidding adieu to their Quebec hosts, landed and made their way to the North Shore Railway station.

At a quarter to seven the homeward bound train, placed at their disposal by the North Shore Company, moved out of the station.

To Mr. J. S. Shearer and Dr. Proudfoot, of the Montreal Committee, credit is due for their untiring efforts to promote the comfort and pleasure of the visitors. Mr. Shearer especially deserves the thanks of one and all for his unfailing courtesy, and his excellent management in the face of considerable difficulty and discouragement. To him the excursionists were certainly largely indebted.

THE EXCURSION TO OTTAWA.

On Saturday, the 26th, a large number of the members visited Ottawa, having with them a goodly gathering of their lady relations. In the programme of the convention the day had been set apart for excursion trips, of which the members had the choice of two, the one to Quebec and the other to Ottawa. The start was made from Hochelaga at 7:30, where a train of parlor cars was in waiting for the excursionists. The varied views along the road were the continual theme of admiration from the party, particularly along the upper portion of the route where the rapids are to be seen crossing the bridge at Buckingham, the pretty views about Montebello, Papineauville, Gatineau and other stations highly appreciated. There was a general sense of surprise, not only at the natural attractions of the route, but at the agricultural state of the country through which the road ran. At Buckingham the lumber yards were a source of astonishment to many who had never been through such huge wood yards before. This brought the party also into the phosphate region and to the gentlemen who took an interest in geology, the many cars of ore along-side the track awaiting shipment afforded subject for keen investigation. A stay of a few moments enabled several of the party to fill their packs with rocks, all glad to have secured specimens of the article from the home of its birth. At East Templeton the quantity of iron ore awaiting shipment there was also the subject of comment, and the view of the material itself opened to many of the gentlemen new ideas of the value of the country through which they were traveling. At several places some members of the botanical section of the party might be seen gathering specimens.

At Montebello the special met the regular down train from Ottawa to Montreal and took on board Mr. W. P. Anderson, Secretary of the Ottawa Reception Committee. That gentleman brought with him copies of the address of welcome to be read to the party on their arrival in the city, cards of invitation to the luncheon to be tendered them and "a souvenir of Ottawa." These were rapidly distributed to all on board by Mr. Anderson, Dr. Baptie and Dr. Thornburn. The souvenir was in great demand among the excursionists and after a glance at it many were the requests made to the Secretary for additional copies to send to friends at a distance, requests which he complied with as far as he could.

The souvenir consisted of a neatly gotten up pamphlet of convenient pocket size of some twenty pages of reading matter, giving the programme laid out for the day, the names of the members of the General Reception Committee, the special committees and other officers, together with a succinct statistical and descriptive account of the expenditure by the city for public improvements since confederation, notes as to the churches, geological museum, the Rideau Canal, the Parliament Buildings, Rideau Hall, the public schools, waterworks, the timber trade and the mineral and other resources of the district. It contained also several well executed lithographic views of the principal points of interest about

the city, and several pages of blank paper for the use of those who wished to make notes. The train rushed on at a rapid rate, and shortly before reaching Hull the first view of Ottawa was had. No stoppage was made at Hull, and the train swept on to the long bridge over the Ottawa River. The view from this structure delighted all, and the only expression of regret was and it was a universal one—that there was not longer time to enjoy it. Looking up the stream was the pretty panorama of the many picturesque islands which stud the water, the channels sprinkled with floating cribs and logs, and further up the rapids of the Little Chaudier and the waters of Deschesne Lake. On the other side of the town, below the bridge, could be seen the spray rising from the "Big Kettle," into which the gigantic mass of water seemed to silently disappear, for the loud roar of the "fall" was lost in the rumble of the wheels, and before and behind was spread the vast array of lumber mills and the yards and the factories which have been created about the Chaudiere and which are justly the wonder of all visitors to the Capital of the Dominion.

From the Chaudiere the party proceeded *via* Duke Street to the central part of the city, passing *en route* the waterworks. Here the full force of the pumps had been put on and a grand jet was thrown up from the yard in front of the pump-house. Both the water and waterworks at Ottawa are unsurpassed in this country.

The Parliament buildings were reached after a rapid drive along Wellington Street. The carriages entered the grounds at the western entrance, passing up along the Supreme Court buildings and between the conservatory and the western facade of the west block and thence to the summer-house west of the Parliament buildings. At this point all alighted and viewed the surrounding scenery. The magnificent panorama drew enthusiastic remarks from all as a view of extraordinary beauty.

The Library was next visited, and the opinion expressed by all was that it was the finest structure of the kind on the continent. The busts of the various statesmen about it were curiously scanned, none more attentively than that of Sir William Logan. The House of Commons and the Senate Chamber were also visited, but owing to the repairs now going on in the former and in the main entrance, and the Senate Chamber being covered up, the rooms could not be seen to fair advantage. After inspecting the buildings the carriages were again taken to the Drill Hall, where luncheon was prepared. The hall had been very tastefully decorated for the occasion. The walls were handsomely draped with bunting and military trophies and decorated with shields bearing the coats of arms of the provinces and chief cities of the Dominion.

Midway along the western hall a stand had been provided for the few distinguished gentlemen who were expected to say a few words on the occasion, and for the representatives of the city appointed to receive them. The little party on the platform consisted of Dr. Dawson, President of the Association, Dr. Gray, of

Cambridge, Mass., the oldest ex-President of the Association, Dr. Newberry, of N. Y., Dr. Carpenter, of London, England, Dr. Szabo, of Hungary, Dr. Gilbert, of Rotherham, England, Dr. Rae, the celebrated explorer, of London, England, His Worship the Mayor, Dr. St. Jean, Mr. C. H. Mackintosh, M. P. for Ottawa, and Dr. Sweetland. Besides the excursionists there were present large numbers of citizens too numerous to mention, including the best representatives of the profession and commercial sections of the city. Mr. Mackintosh, member for the city, briefly said he was happy to be present at the assembly and asked His Worship the Mayor to take the chair. Dr. St. Jean at once complied and then read a warm address of welcome.

He then requested the company to proceed to lunch, which all were ready for after the long journey.

The committee deserves the greatest credit for the lavish entertainment. Of everything on the *menu* card there was abundance and to spare. The attendance was also excellent and ample. After luncheon the chairman said that it would afford great pleasure to hear a few of the gentlemen present.

Mr. Dawson, of McGill College, Montreal, in reply, said that he had very much pleasure, on behalf of the association of which he was president, to return the society's hearty thanks for the cordial greeting which had been extended them by the citizens of Ottawa, and much more of appropriate character.

Dr. Carpenter, on behalf of his fellow countrymen and himself, was happy to say that there was never a more delightful meeting of the association, and he would beg to return their most cordial thanks to the citizens of Ottawa for the fine reception which had been accorded them, which he could assure them was thoroughly appreciated by them.

Prof. Asa Gray, Dr. Jno. Rea, Mr. Perley, Prof. Newberry and Dr. Grant followed with similar remarks.

Three cheers for the Queen terminated this part of the programme.

After the speeches the party dispersed in various directions, many going to Rideau Hall, Beechwood and other places. All rendezvoused at the Union Station at six o'clock and discovered that the train would not leave till eight o'clock. In consequence of the unexpected delay many of the party were the welcome transient guests of several who had gone to the station to see them off. Our own personal thanks for courteous attentions are due to Mr. and Mrs. McLeod Stewart.

On Sunday, August 27th, the annual prayer meeting, inaugurated at the Saratoga meeting, was held and was participated in by Principal Dawson, Prof. H. C. Hovey, Prof. Lovewell, Prof. Bassett, Rev. Dr. Mathewson, Rev. James McCaul, Rev. Mr. Hungerford, Prof. C. W. Hall and others.

NOTE.—An account of later proceedings will be given hereafter with full report or copious abstracts of some of the more important papers, especially one on Anthropology by Prof. F. W. Putnam.—[ED.

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Highest barometer during month 29.24, on the 5th of September. Lowest barometer during month 28.78, on the 17th.

Highest temperature during month 104°, on the 13th. Lowest temperature during month 46°. on the 20th.

Highest velocity of wind during month 33 miles per hour, on the 19th.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Aug. 21st to Sept. 1st.	Sept. 1st to 10th.	Sept. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	62.2	53.9	62.3	59.4
Max	88.8	81.2	92.6	87.5
Min. and Max	75.3	67.5	77.5	73.4
Range	26.6	27.3	30.3	28.1
TRI-DAILY OBSERVATIONS.				
7 a. m.	65.0	60.3	69.4	64.9
2 p. m.	82.0	82.0	89.0	84.3
9 p. m.	78 0	68.0	73.0	70.3
Mean	72.0	69 0	76.2	72.1
RELATIVE HUMIDITY.				
7. a m.	.86	.82	.83	.84
2 p. m.	.51	.45	.50	.48
9 p. m.	.80	.73	.75	.76
Mean	.71	.66	.69	.72
PRESSURE AS OBSERVED.				
7 a. m.	29.06	29.11	28.97	29.04
2 p. m.	29.03	29.07	28.95	29 01
9 p m.	29.03	29.07	28 98	29.02
Mean	29.04	29.08	28.97	29.03
MILES PER HOUR OF WIND.				
7 a. m.	7.0	4.1	15.1	8.7
2 p. m.	13.4	10.0	26.9	16.8
9 p. m.	7.8	9.7	19 0	12.1
Total miles	. .	2396	5168	. .
CLOUDING BY TENTHS.				
7 a. m.	2.5	3.7	3.3	3.1
2 p. m.	5.4	4.3	1.9	3.8
9 p. m.	3.2	1.1	1.5	1.8
RAIN.				
Inches	.00	.00	.12	.12

BOOK NOTICES.

REPORT OF THE COMMISSIONER OF EDUCATION FOR 1880. Hon. John Eaton, Commissioner; 8vo. pp. 914.

The eleventh annual report of the Commissioner of Education, covering the year 1880, has been received.

We learn from it that the present year has been marked by a great increase in the amount and value of the information received at the office with reference to the conduct of education in our own and in foreign countries, and by a corresponding increase in the public demand for the distribution of information. The means allowed the Office for carrying on the interchange of intelligence are entirely inadequate, whether regard be had to specific inquiries or to information which should be published in the general interest of this department of public affairs.

Seven circulars of information and six bulletins have been published during the year, comprising among others the following subjects: College libraries as aids to instruction; rural school architecture, with illustrations; English rural schools, with illustrations; a report on the teaching of chemistry and physics in the United States; vacation colonies for sickly school children; the Indian School at Carlisle Barracks; industrial education in Europe; medical colleges in the United States.

The number of American correspondents of the Office, including officers of State and local systems and institutions of learning, is 8,231, or more than four times the number at the beginning of the present decade. To the material derived from these sources must be added the foreign matter, reports and periodicals, all of which must be examined and summarized for the report.

In introducing the statistical summary the Commissioner explains the scope and value of a perfect system of tabularization and points out some of the deficiencies in the plans pursued in various States and localities. Great improvement in this respect is noticeable in the returns and reports received at the Office, and every year increases the value of the figures for purposes of study and generalization. So far as practicable the statistics in the present report include a comparative view of education for the decade ending 1879-80.

The total school population in the States for 1880 is 15,351,875; number enrolled in public schools, 9,680,403; average daily attendance, 5,744,188, four States not reporting. The school population of the Territories is 184,405, Idaho and Wyoming not reporting; enrollment in public schools, 101,118; average daily attendance 61,154, two Territories not reporting. The percentages of enrollment and average daily attendance are highest in Massachusetts and lowest in Louisiana.

We select a few points of interest regarding our own immediate region. In Missouri growth meets us for both 1879-80 and for the decade which then closed, the enrollment in the public schools in 1879-80 exceeding by 26,594 that of the year before and by 5,263 the increase of youth entitled to free schooling, while 11,710 more children were in average attendance daily in 546 more schools, under teachers better trained and changed less frequently than in former years. Permanent school funds increased by $1,408,580, though school property was rated $1,646,599 less in value and current school income fell off $62,671.

For the whole decade there was great advance at every point, the additional public school enrollment including at the close 57,265 more youths than had meantime come of school age, making thus a deep inroad into the mass of the previous illiteracy, while an average of 32,108 more of the enrolled were in the schools each day. This, with an increase of 1,699 public schools, of 1,631 teachers for them, of $2,333,287 in receipts for schools, and of $4,261,383 in the permanent funds for the support of them, is a record of which the State may well be proud.

In Kansas,—progress at almost all points marks 1879-80 as compared with the preceding year: 28,416 more persons of school age, 23,000 more in the State schools, and 13,952 more in daily attendance, with provision for this increase in 310 more school-houses. There were 858 more teachers engaged at somewhat higher pay and an addition of $291,944 to the current school revenue. Still further evidence of progress appears in 163 more districts with uniform text books, 673 more with graded courses of study, and a rise of $225,908 in the valuation of school property.

This Report is a work upon which a vast amount of labor has been expended and from which all teachers and others interested in education can obtain information on all appropriate points.

SPARKS FROM A GEOLOGIST'S HAMMER. By Alexander Winchell, LL.D., Second edition, 12mo. pp. 400. S. C. Griggs & Co., Chicago; $2.00.

The first thing that attracts attention upon picking up this book is its extremely tasteful binding and the general excellence of its make up. After that the contents engage the reader's mind and hold it continuously till the last page is reached. As long ago as 1870 the writer purchased a copy of this author's "Sketches of Creation" and found it most fascinating and suggestive reading. Since then he has hastened to obtain copies of each successive work by Professor Winchell, including "The Preadamites," and now the volume under consideration In all the same accuracy of expression, the same wide range of information and thought and the same scholarly though popular manner prevail, so that it is adapted to all classes of intelligent readers, from professor to pupil.

The present volume is devoted to a variety of topics, descriptions, essays, and discussions of scientific subjects which are classified as Æsthetic, Chronologi-

cal, Climatic, Historical and Philosophical. Under each of these heads are several appropriate chapters, such as a description of Mont Blanc and the Mer de Glace, The Old Age of Continents, A Grasp at Geologic Time, Geological Seasons, A Remarkable Maori Manuscript, The Genealogy of Ships, Grounds and Consequences of Evolution, etc. All of these are treated in an attractive manner, popular, but at the same time comprehensive and practical. No reader having bought a copy of this book will regret it nor will he fail to read it more than once if he has any real desire to acquire the most advanced ideas and the most reliable information on the subjects treated.

THE COUES CHECK LIST OF NORTH AMERICAN BIRDS. Second edition; 8vo. pp. 144. By Elliott Coues, M. D., U. S. Army. Estes & Lauriat, Boston, 1882. For sale by M. H. Dickinson; $2.00.

The original of this work, which now assumes the character or position of a dictionary of the etymology, orthography and orthoëpy of the scientific names of birds in addition to its former character of a catalogue of such names, was published in 1870 and seemed to cover the necessities of ornithologists at that time. But so rapidly has the science advanced that revision has been rendered necessary and a large number of new names has been added.

The most interesting portion of the work to the ordinary reader will be the chapter entitled "Remarks upon the Use of Names." In this a full account of the derivation of the technical terms used by ornithologists is given, also of the rules for the proper spelling and pronunciation of such words. These rules are not applicable solely to ornithological terms and names, but are of general application and may be beneficially studied by all.

The great bulk of the work is devoted to a revised check list of the birds of this continent and a list of the author's works upon the subject. A very useful feature of the former is the accent marks showing the proper pronunciation of all names. Nothing so thorough has ever been published so far as we know.

FLOATING MATTER OF THE AIR. By John Tyndall, F. R. S.; 12mo pp. 338. D. Appleton & Co., N. Y. For sale by the Kansas City Book & News Co., $2.00.

The object of this work is to demonstrate the existence of germs in the atmosphere which produce and spread dangerous and fatal diseases, with numerous accounts of interesting experiments made by the author and other scientists, both as to their existence in the air and their non-production in the absence of atmospheric air; the triumphs of the antiseptic system of surgery and the vital importance of pure air and pure water as sanitary agents. The most valuable chapters are those upon Dust and Disease, The Optical Deportment of the Atmosphere in Relation to Putrefaction and Infection, Researches on the Deportment and Vi-

tality of Putrefactive Organisms, Fermentation and its Bearings upon Surgery and Medicine, and Spontaneous Generation.

It is a deeply interesting book, with a practical bearing which affects the welfare of mankind, combined with a broad philosophical treatment adapted to the most advanced thinkers and humanitarians of the age.

COLLET'S HISTORICAL RECORD. By Oscar W. Collet; 2 Vols. 8vo., St. Louis, Mo.; $10.00.

Mr. Oscar W. Collet, of St. Louis, is receiving subscriptions for a work to be entitled, "The Historical Record," a compilation of all documents, wherever preserved, containing historical facts relating to St. Louis, the State of Missouri and regions adjoining, including Louisiana and New Mexico, of which copies have been, or can be procured. The publication will comprise unpublished official documents (including many from abroad), and some already in print but not accessible; statements found in depositions on file in different offices of record; manuscripts, embracing journals, narratives and letters; some pamphlets out of print and very scarce; a few old maps and plats; also, genealogies, with a few brief sketches (not biographies) of some of the members of families to which the genealogies relate.

Translations of French, Spanish and Italian documents will be given in parallel columns with the originals.

Although the work does not embrace archæology, as such, it will contain many pages interesting to archæological students; such as artotype representations of some unique, or typical objects, utensils and implements, discovered in Missouri; also, reproductions of unpublished plats, and descriptions, some dating sixty years ago, of important ancient earthworks. The accuracy of such plats, etc. as represent remains still in existence has been verified by explorations specially undertaken for the purpose.

The work will be enriched with numerous notes, not only by the compiler, but by several of the first historical writers of the day.

The price, considering the nature and magnitude of the work and the large expense attending its production, seems to indicate that the compilation and publication of the "Record" have been undertaken rather as a labor of love than for gain.

Mr. Collet's work is the most important of its class ever attempted in this State; and it may well be hoped that the effort to produce an historical monument of such enduring value will meet with general practical encouragement. The announcement of this contemplated publication has called forth many warm approvals from different parts of the country as well as Missouri; and, among others, the following interesting letter from the veteran historian of the West:

ELIZABETH, N. J., 1882.

Mr. Collet is doing a grand work: he is redeeming the United States as fast as he can, from one of its greatest sins. It was its bounden duty on acquiring

Louisiana, Florida, Texas, New Mexico and California, to take and preserve the ancient archives of those provinces, rich in documents and well preserved till then. Where are they now? Our government took no steps to preserve them at all; it left everything to decay and destruction, and in New Mexico, as though theft and carelessness did not work quick enough, one of the wretched beings sent there as governors actually sold great quantities of the ancient archives for waste-paper, destroying documents that can never be replaced.

Mr. Collet's noble volume will after great toil and labor bring together much relating to the early history of Upper Louisiana, and the public will owe him a great debt which I hope it will appreciate, I shall not only be among the subscribers for the "Historical Record," but shall take occasion to call the attention of scholars to the work to add a few more.

JOHN GILMARY SHEA.

The work will be printed in first-class style and as the edition will be limited to 500 copies, subscriptions should be sent in without delay.

F. F. H.

OTHER PUBLICATIONS RECEIVED.

Report of the Chief Signal Officer, U. S. Army, for 1879; Report of the U. S. Commission on Fish and Fisheries, for 1879; *Humboldt Library*, No. 36, Lectures on Evolution, by Thomas H. Huxley, 15c; The *Consulting Engineer of Canada*, Vol. I, No. 1, monthly, Toronto, $1.00; Washington University, 25th Anniversary, An Address by Chancellor W. G. Eliot; *Knowledge*, Part X, Vol. II, London, edited by Prof. R. A. Proctor, Weekly, 10s. 10d. per annum; Report on the Character of 600 Tornadoes, John P. Finley, Signal Corps, U. S. A.; *The Poultry Review and Stock Journal*, Monthly, Washington, D. C., $1.00 per annum. Annual Report of the Kansas City Public Schools, 1881-2, Prof. J. M. Greenwood.

SCIENTIFIC MISCELLANY.

SOME RECENT IMPROVEMENTS IN THE MECHANIC ARTS.

BY F. B. BROCK, WASHINGTON, D. C.

NOVEL STEAMSHIP.—In the construction of this improved steamship the hull is made to curve inwardly above the water-line, and an elevated cabin is supported above and is of less width than the hull, whereby the waves are caused to act with less force upon the vessel, and the tendency to tip or roll is diminished.

Intermediate tubular stanchions or columns pass from the emigrant cabin to a point above the elevated cabin, and are adapted to support the elevated cabin and serve as ventilating shafts for the emigrant quarters.

ROOFING-TILE OR PLATE.—In this invention the tiles are provided with plain lap-borders, the remainder of their surface having parallel corrugations or ribs rising in relief above the plane of the plain borders, whereby a uniform bearing surface is provided. The corrugations are arranged in the direction of the slant of the roof.

STEAM ENGINE RECORDER.—A novel improvement provides a rotary paper carrier, with mechanism for moving it, and a marker with means for imparting to such marker in a given period upward movements corresponding in number to that of the strokes of a steam-engine piston during such period, in order that marks indicative of the number of the strokes may be made by the marker on a sheet of paper moved as described. The paper carrier is capable of being used for varying pressure of the steam during a stroke of a steam-engine piston and for registering the speed of the engine or number of strokes of its piston in a given time.

ELECTRIC BURGLAR ALARM.—This novel burglar alarm is so arranged that the opening of a door or window breaks a primary circuit and closes a secondary one. The alarm is kept sounding by the current through the secondary circuit, and cannot be stopped by closing the door or window.

NOVEL FIRE-ESCAPE —An ingenious inventor has provided a flexible chute which, when in use is adapted to be anchored at its lower end out in the street by cords so as to make an inclined covered way for the purpose of escaping from the burning building. Weights on the cords which are attached to the upper end of the chute, pull it open when released. When not in use the chute is inclosed in a case in the window-sill, which is held closed by a latch in the window-sash. When the sash is raised it strikes an alarm.

DEVICE FOR HANGING VENETIAN BLINDS.—In this invention, to the ends of the heavy top slats are affixed castings with an irregular angular opening in each which governs the position and operation of the blind. The shade, by means of these, may be, with all its attachments, lifted off or placed upon supporting pins in the jambs of the window.

LIME vs. POWDER.

On Monday a series of interesting experiments took place in the workings of the Wharncliffe Silkstone Colliery, near Sheffield, the object being to test the new method of winning coal by the use of compressed lime instead of blasting-powder. These collieries, which are amongst the largest in South Yorkshire, employing over 600 hands, were opened in 1854, and have been remarkably free from ex-

plosions, though gas is met with in the workings. The experiments, which were witnessed by the officials of this and other collieries, took place in the Parkgate seam. A hole about three inches in diameter and four feet deep was drilled through the solid coal, and cleaned out. A perforated iron tube was then inserted, and the lime cartridge, three inches long, put in When the lime had been rammed home and the hole made up a force pump was used to inject water into the bottom of the tube around the cartridge. Simultaneously with the injection of the water the rending process began, and in thirty minutes about ten tons of coal came down almost in an unbroken mass, one piece being nine feet long. Of the whole of the fall not more than 6 per cent of the coal was "small," a much smaller percentage than under the old system. A second trial was made in another part of the pit, and the result was exceedingly satisfactory to the colliery officials. It is anticipated that compressed lime will eventually supersede the use of blasting powder, and thus revolutionize the system of winning coal.—*Oldham Chronicle.*

EDITORIAL NOTES.

THE large amount of space given to the Proceedings of the American Association at Montreal in this number of the REVIEW, will be found well appropriated by every person who takes the pains to read the account given. It is only intended as a popular report and contains much of a personal character that will not appear elsewhere. Our experiences were exceedingly pleasant, from the rushing, rapid trip over the Wabash, the Great Western of Canada and the Rome, Watertown & Ogdensburg R. R. to the quiet but charming sail down the St. Lawrence. We made the three thousand mile trip, including the excursions, without an unpleasant adventure, and returned home with nothing but the most agreeable recollections of the whole affair. The only regret felt is that we could not have spared two whole weeks for it instead of crowding so much into eleven days.

ONE of the most interesting and valuable exhibits at the Montreal meeting was that by Prof. Bassett, of Crawfordsville, Indiana. It consisted of several slabs of limestone covered with crinoids of the most perfect and beautiful forms. These slabs varied in size from two to six square feet and the crinoids, worked out with the utmost care and delicacy by the Professor's own hand, and measuring from a few inches to several feet in length, lay in great profusion and in all degrees of entanglement all over them. Professor Bassett has purchased the quarry containing them, said to be almost the only one known in the country and will give his attention to taking them out for the supplying of museums and private collections. He has made some very interesting discoveries concerning the habits of these curious animals which he proposes to communicate to the public soon, through the columns of the REVIEW.

PROFESSOR YOUNG, of Princeton College, will use the new telescope, for the present, mainly in stellar spectroscopy, a department of research which promises interesting results and requires powerful telescopes. The Princeton telescope ranks second in the United States and fourth in the world.

MR. JOHN ADAMS, of Boston, has taken out a patent for a device intended to be used as a brake on steam vessels for the prevention of collisions. It is modeled after the pectoral fins of a fish and has been tested with complete success on a ocean steamer, stopping her within ten feet several times when sailing twelve miles an hour.

THE transit of Venus in December is now filling the minds of the scientific men of the whole world. Every civilized government is extending aid, and simultaneous observations will be taken from every available portion of the globe. As this phenomenon will not again occur for one hundred and twenty-two years the astronomers of the present day will make the most of it.

PROFESSOR J. D. PARKER, who has frequently assisted us in the preparation of the REVIEW, has received the appointment of Post Chaplain in the U. S. Army, and has left Kansas City to assume its duties at San Antonio, Texas. It is a good selection and Professor Parker has the ability to fill the position admirably.

THE hottest September day on record in this vicinity was the 12th, when the mercury reached 104° at Kansas City, 105° at Lawrence, Kansas, 100° at St. Louis, and about the same at all neighboring points, and was accompanied by a fierce hot wind that scorched vegetation like a flame and filled the air with clouds of suffocating dust. On the 18th, after nearly two month's drouth, a severe rain storm, amounting to over two inches, as reported to us, occured, doing much damage in this city and vicinity.

DR. D. G. BRINTON, of Philadelphia, is about to commence the publication of a series of works under the general title of Library of Aboriginal Literature. These works will be published in the original tongues with English translations and notes. The first of the series will be "The Maya Chronicles." The price of each volume will be $3.00.

THE Edison incandescent light in New York City seems to be regarded now as a success. New burners can not be put up fast enough to supply the demand, and there is no prospect of a return to gas in the buildings now illuminaed by electricity. This means that the new light is more agreeable than gas, and cheaper.

PROF. A. N. LEONHARD, of St. Louis, has recently published a very full list of the minerals of Missouri, with the localities where found, etc. As Prof. Leonhard was formerly connected with the State Geological Survey and is now in charge of the department of Mining and Metallurgy in the Washington University, this list may be relied upon as very accurate and complete.

Two comets are now engaging the attention of astronomers. One was discovered first by E. E. Barnard, of Nashville, on the morning of Sept, 14, and is consequently called the Comet Barnard. It is only to be seen by the use of the telescope, and according to the Boston *Science Observer*, its orbit does not bear any resemblance to that of any known comet. The other was discovered first by Mr Cruls, at Rio Janeiro, Sept. 11; and on the 18th by C. C. Miller, of Leon, Kansas. It is a very prominent object in the eastern sky, on any clear morning, at about 4:30. The nucleus appears to be heading directly towards the sun, while the tail lies to the westward.

P. BLAKISTON SON & CO. announce a handsome edition of Harley's Diseases of the Liver, to be ready in October. It will be an octavo volume, illustrated with colored plates and wood engravings. It is offered as the only thorough book on the subject now before the profession.

ITEMS FROM PERIODICALS.

THE contents of the *Popular Science Monthly* for October are as follows: Massage: Its Mode of Application and Effects, Douglas Graham, M. D; Literature and Science, by Matthew Arnold; What are Clouds? by C.

Morfit; The Past and Present of the Cuttle-Fishes, by Dr. Andrew Wilson (illustrated); Mozley on Evolution, by Herbert Spencer; Explosions and Explosives, by Allan D. Brown; The Utility of Drunkenness, by W. Mattieu Williams; Delusions of Doubt, by M. B. Bill; The Progress of American Mineralogy, by Professor G. J. Brush; Industrial Education in the Public Schools, by Professor H. H. Straight; Physiognomic Curiosities, by Felix L. Oswald, M. D.; The Formation of Saline Mineral Waters, by M. Dieulafait; A Partnership of Animal and Plant life, by K. Brandt; Sketch of Professor Rudolf Virchow, (with Portrait); Editor's Table: Matthew Arnold on Literature and Science—The Montreal Scientific Meeting; Literary Notes; Popular Miscellany; Notes.

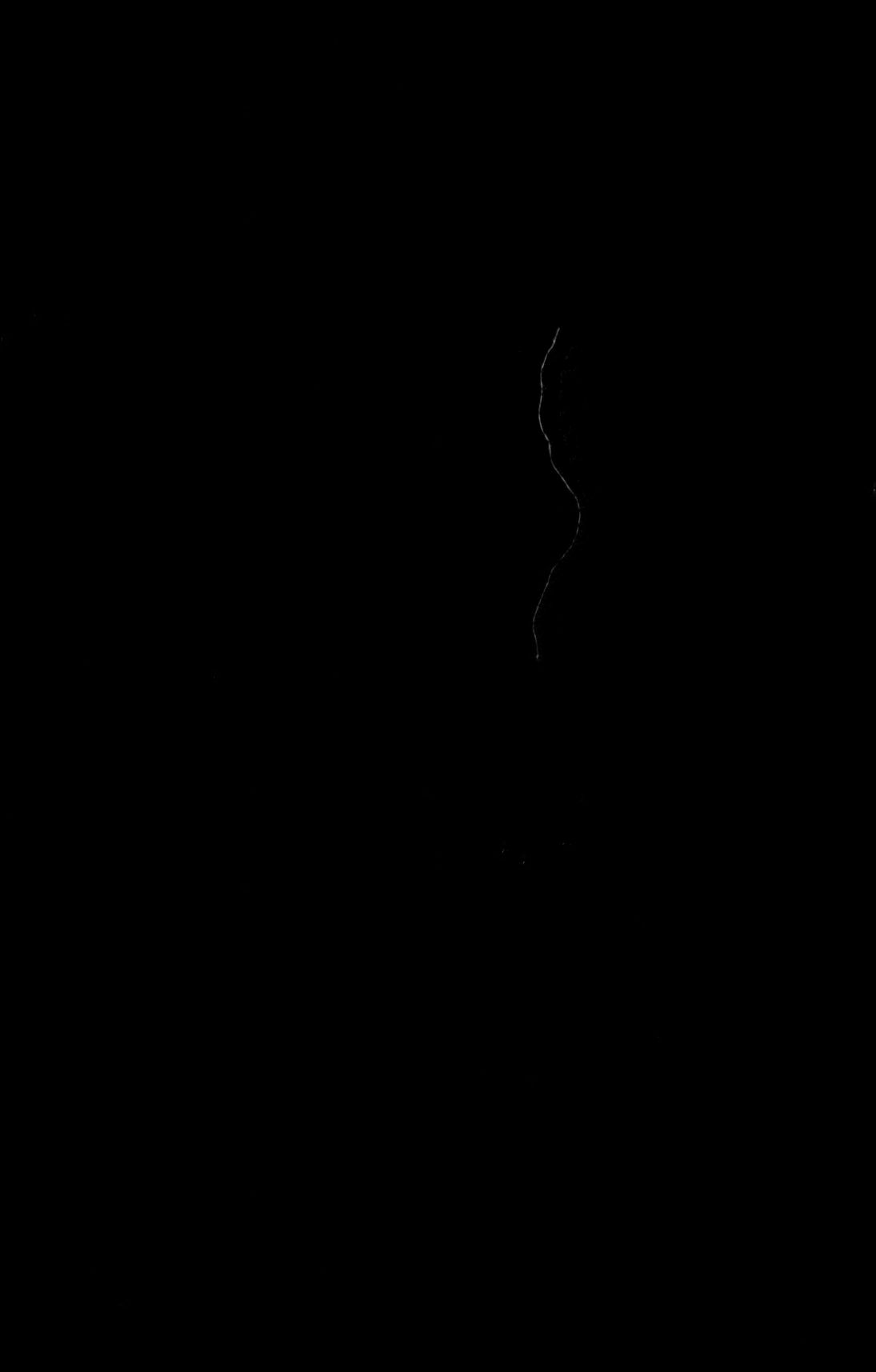
THE *Atlantic Monthly* for October contains the following attractive articles: Two on a Tower, XXVIII—XXXII, Thomas Hardy; Among the Sabine Hills, Harriet W. Preston; Storm on Lake Asquam, John Greenleaf Whittier; An English Interpreter, Horace E. Scudder; Cicada, John McCarty Pleasants; Studies in the South, VIII; And Mrs. Somersham, Agnes Paton; Fallow, Lucy Larcom; University Administration, W. T. Hewett; Pilgrim's Isle, Thomas Williams Passons; The House of a Merchant Prince, XIX., XX, William Henry Bishop; The Nation of the Willows, II, F. H. Cushing; A Shadow Boat, Arlo Bates; The Red Man and the White Man; The Salon of Madame Necker; The Contributors' Club; Books of the Month.

THE *North American Review* for October opens with an article on "The Coming Revolution in England," by H. M. Hyndman, the English radical leader. O. B. Frothingham writes of "The Objectionable in Literature." Dr. Henry Schliemann tells the interesting story of one year's "Discoveries at Troy." Senator John I. Mitchell, of Pennsylvania, treats of the rise and progress of the rule of "Political Bosses." Professor George L. Vose, of the Massachusetts Institute of Technology, contributes an article of exceptional value on "Safety in Railway Travel," and Prof. Charles S. Sargent, of the Harvard College Arboretum, contributes an instructive essay on "The Protection of Forests." The *Review* is sold by booksellers and newsdealers generally.

THE *Observer*, Falls City, Nebraska, says of the REVIEW: "This excellent monthly is continually growing in favor. It is fresh and original and numbers some of the ablest contributors on the continent."

THE Wichita *Eagle* says: "The Kansas City REVIEW should reach the table of every professional, literary and scientifically inclined man in Kansas. It is a splendid publication, full of matter pertaining to the formation and wonders of the trans-Mississippi country and general scientific papers of great worth and absorbing interest. Two dollars and fifty cents per annum is wonderfully cheap for a magazine of such size and worth, and which is published by Hon. Theo. S. Case, not for the money there might be in such a publication, but for his love of the work."

As usual, the REVIEW is full of interesting reading matter. The original articles are on subjects that interest most readers and searchers after knowledge. This work is a credit to the intelligent forces of the West and should be liberally supported. In the East it is looked upon as authority.—*Herald.*



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